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SUGGESTED PROJECT DESIGN
MAURITANIAN COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

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INTRODUCTORY NOTE

The Mauritanian component of U.S. Agency for International Development (USAID) assistance to the OMVS 1/ Regional Grain Stabilization Project is authorized under Non-Capital Project Paper, Project No. 625-11-150-600, April 2, 1972, and revised March 1972. The long-run objective of this project is to involve the countries of Mali, Mauritania, and Senegal (members of the OMVS) in a regional program to manage cereal grain supplies. The project authorizes technical assistance and other funding inputs for an initial effort (FY 72-FY 75) to develop relevant and complementary domestic cereal grain supply management programs in each OMVS member country as a basis for initiating effective regional cooperation.

PROJECT SETTING AND RATIONALE

Mauritania has great need for a program which would help increase cereal grain production and develop a stable market for that production. Production has remained at 100,000 MT per year for the past 10 years, according to official figures, while population has been growing at a fairly low rate.

Rainfall is not over 600 mm. in the most favored sections of the country and is closer to 200 to 300 mm. in most of the agricultural areas. Often it does not rain at all and 3 of the past 4 years have been drought years. Although official production figures float along at 100,000 tons, good year and bad, drought probably cuts into production by 30 to 50 percent, and drops it to almost zero in many areas.

As a consequence there are seasonal and geographic shortages almost every year. That portion of the crop which is marketed, estimated at approximately 25,000 MT, is handled by small traders who buy at low prices on credit and resell at prices marked up from 3 to 4 times the purchase price. Drought season prices may reach 100 CFA/kilo or higher.

Mauritania, even in a normal year, must make up its food deficits through imports. These imports total close to 50,000 MT per year, about half of this is rice and the rest sorghum and millet. Most sorghum and millet has been imported from Mali but, during the past year or two, Mali has effectively cut off this trade, causing serious shortages in Eastern Mauritania.

1/ Organization for Development of the Senegal River Valley (OMVS) was created March 11, 1972, as a successor to the Organization of Sengal River States.

Given this set of conditions, a successful grain stabilization program is an urgent development need in Mauritania, both for its potential to solve internal production and distribution problems and for the hope of increasing regional grain trade through the OMVS mechanism.

Unfortunately, Mauritania is deficient in most of the elements necessary for a successful market stabilization effort, including:

- No existing government organization with cereal marketing responsibility.
- No cereal marketing policy.
- No trained cadre in marketing, storage, or sanitation.
- No storage facilities except at Kaedi and Selibaby.
- Extremely poor transportation system.
- Lack of a potential buying system (e.g., co-ops) in the countryside.
- An inadequately supported extension service.
- A minimal agriculture research system.
- An acute lack of resources to improve these deficiencies.

Mauritania does possess some important assets. Not the least of these is the acute awareness of officials at all levels of the need for action, both to increase food grain production and, concurrently, to provide a stable market. Moreover, as the result of earlier efforts at cereal marketing, most officials are knowledgeable of the elements of a grain stabilization program. They also have very strong opinions on why earlier programs failed.

Another asset is the potential for increased grain production, although within the limits of a capricious climate.

Although there is no government grain marketing organization in Mauritania such as OPAM in Mali, or ONCAD in Senegal, there is a government trading company, SONIMEX. This organization has a monopoly of trade in basic staples such as sugar and imported rice, and handles all donated grains. It, therefore, has an infrastructure of warehouses, stores, and personnel experienced in transport, selling, and warehousing, and offers an opportunity for nurturing the development of a grain stabilization program.

The Government of Mauritania (GOM) has succeeded in interesting various international organizations in its grain problem. The European Development Fund (FED) has indicated an interest in supporting the construction of grain storage. The World Food Program (PAM) has donated cereal grains to alleviate food shortages. The Government of Mauritania and international agencies working in an integrated program could successfully develop the needed infrastructure, market policy, and supply management mechanisms to arrive at a functioning grain stabilization program over the next 10 years.

The Mauritania Government policy on grain marketing is best indicated in its "Second Plan of Economic and Social Development, 1970-73:"

> "We do not have available at present sufficiently precise information to determine any objectives in millet production...
>
> "In awaiting the time when solid statistical information might be available, the state will take no measures tending to increase millet production, except the completion of small retention dams of which a certain number should be constructed in the next few years.
>
> "It is towards a policy of stabilization of markets, of a better distribution of the product, that we should direct ourselves from now on.
>
> "It is a question of launching, and in the least delay, an organization for the stabilization of markets. This organization should be given the means of storage which will permit it to store millet bought at a price profitable for the farmer and to resell it in times of scarcity at a price advantageous to the consumer. Even though it does not entirely supplant speculating middlemen, it will change their conduct to the extent that it will set the prices at which merchants will be obliged to follow in order to buy and sell.
>
> "This organization, which could be SONIMEX, should address itself to solving problems of transportation and to judiciously locate its storage warehouses."

The goals and objectives of the grain stabilization project can thus be seen to be in complete accord with and aimed to assist in the attainment of these stated objectives of the Government of Mauritania.

Most millet and sorghum in Mauritania is produced in the Senegal River Valley. Two cropping methods are followed; the first, relying on natural rainfall, calls for seeding in July and harvest in October. The second method is to plant along the river border as the flood waters recede from December to February. These methods are followed in the rest of the country, also, the latter in bas-fonds, particularly where retention dams have been built.

The most complete figures on production and consumption of sorghum and millet in Mauritania appeared in the 1968 SEDES Study, "Commercial Exchanges in Mauritania," and are presented by the WF Project of di Furia 1/as follows:

1/ On the Conditions and Possibilities to Create in the Islamic Republic of Mauritania a Regulative and a Reserve Stock of Sorgho. di Furia, Patteson, Pollaris, WFP, Dakar, May 16, 1970.

Table I.--Sorghum and millet production and consumption by region

Farmer Circles	Region	Production	Consumption	Surplus (+) or Short (-)
		metric tons		
Hodh Orient	1	17,016	19,216	- 2,200
Hodh Occid	2	8,410	10,860	- 2,450
Assoba)	3	10,885	13,435	- 2,550
Guidimaka)		23,053	11,053	+12,000
Gorgol	4	15,845	11,497	+ 4,350
Tagant)	5	3,083	3,483	- 400
Brakna)		19,977	18,527	+ 1,650
Inchire)	6	112	1,232	- 1,120
Trarza-Nkchtt)		5,978	12,978	- 7,000
Tiriaz-Advar) B. duLevrier)	7&8	1,062	3,442	- 2,380

The table above represents production in a normal year, and demonstrates that many areas are deficit even when rainfall is favorable. Serious drought, however, can reduce production by 30 to 50 percent.

To internal production must be added imports from Senegal and Mali, especially the latter. Most estimates place the level of net sorghum and millet imports at about 5,000 MT per year. The study team believes the level of imports is much higher, and feels the estimate by the Minister of Commerce of 25,000 MT per year is much closer to reality.

Assuming a normal production of 100,000 MT and imports of 25,000 MT, average consumption of millet and sorghum would be 100 kilos per capita under the best circumstances. Although this can be supplemented by various animal products, it is nevertheless only half the level of per capita consumption considered normal in Mali and Senegal.

We estimate that 30,000 to 35,000 MT of domestic production reaches commercial markets, plus the 25,000 MT of imports from Mali and Senegal. This is substantial trade, and it is hardly correct to say that a market does not exist in Mauritania. It is a highly speculative market, however, conducted almost entirely by petty traders. These traders habitually buy grain from farmers during the harvest period for 5 to 10 CFA per kilo. They then sell it throughout the rest of the year at prices ranging from 15 to 30 CFA. During drought years the farmer price may rise to 20 to 30 CFA per kilo. Resale price to consumers will inflate to 60 to 100 CFA per kilo.

Few, if any, dealers have storage facilities which enable them to store grain from one year to the next. Often the resale at inflated prices is to the same farmers who sold it at very low prices earlier the same harvest year. This shortage of grain is most acutely felt by producers June through September, the soudure period. Rather than pay cash, farmers will mortgage their next crop at the low prices indicated.

Much grain is resold in the area where it was purchased. However, as the table above indicates, much of it must be transported from surplus to deficit areas, and the high cost of transportation causes at least part of the price inflation already noted.

Transport rates are set by the state, and are 23 to 26 CFA per ton kilometer between Rossa and Kiffa, and 28 to 34 CFA per ton kilometer on the track between Kiffa and Nema. Thus, a sack of cement, fertilizer, or grain has more than doubled in cost between the port of entry at Rosso and Nema. Indeed the Government has found it necessary to subsidize part of the transport of certain foodstuffs and cement destined for the more distant regions. Many regions are in fact cut off one from the other during the rainy season, June through September.

These transportation difficulties have serious implications for a grain program. For one thing, a stabilization effort should attempt, as far as possible, to administratively link a surplus region with a nearby deficit area to minimize grain transfers. On the production side, high transport costs for fertilizer, which must be imported through Rosso, require a very high marginal return from fertilizer before its sale becomes feasible.

The team feels that there are substantial opportunities for increasing sorghum and millet production in Mauritania, particularly in the Senegal River Valley and in bas-fonds in other areas. Production increasing practices would include a wider use of animal traction, improved varieties, improved seeding and cultural practices, and, in some areas, the application of high analysis fertilizer, especially nitrogen.

Some research has been conducted on these problems at the IRAT station at Kaedi. Unfortunately, the researcher in charge of sorghum and millet research at Kaedi has been reassigned out of Mauritania, and in his absence the results of his experiments were unavailable. To the team's knowledge, little or no applied research or field trials have been conducted off the Kaedi station.

The Government of Mauritania has in the past launched campaigns to increase cereal production through increased use of animal traction, most recently in the First Region. An evaluation of the First Region program by GOM officials concluded that the campaign was very successful in increasing millet production, but that the program was a failure because a market stabilization program had not been developed concurrently. As a consequence, with substantial increased production, prices plummetted. Farmers could not repay their equipment loans, became discouraged, sold off their draft animals, and dropped out of the program.

The team suggests that any grain stabilization program in Mauritania include a production element which, during the first 3 years of the project, would emphasize:

- Assistance to an expanded program of millet and sorghum at the Kaedi research station, including extensive field testing in the various producing regions of the country.

- Strengthening the extension service cadre and program in the region chosen for launching a pilot market stabilization program.

- Development of a seed multiplication program of improved varieties.

GOM officials correctly believe that a production campaign cannot succeed unless a stabilized market is developed at the same time. The team suggests that the converse is equally true, especially where production, even under ideal conditions, continues to lag behind increasing food requirements.

Two recent and excellent studies have already addressed the problems of grain market stabilization and storage in Mauritania, including the one by di Furia previously cited and another by an Argentine expert, Cesar Lopez, on the possibility of constructing hermetically sealed subterranean silos for long-term storage. In general, these reports recommend:

- That storage for disaster relief and market stabilization be considered separately.

- That action on a market stabilization program be deferred due to the lack of infrastructure.

- That construction on five disaster-relief storage silos at Nouakchott, Kaedi, Makta-Lahjar, Kiffa, and Aioun be undertaken.

- That these silos have a total capacity of 5,500 MT. Lopez increased the recommendation on total capacity to 15,000 MT.

- That a subterranean, hermetically sealed storage design be used.

These studies are important not only for their detailed study of the situation, but because they form the basis of a FED program to assist Mauritania construct grain storage facilities.

The study team considers these structures an important part of any stabilization program. We basically agree with the earlier studies, but urge reconsideration of certain recommendations as follows:

- That, at this time, the structures be built and used for disaster relief storage in all regions but one. In this one region a market stabilization and production program should be launched on a pilot basis to test and develop market policy, train a cadre of managers and technicians, develop a cooperative system of buying points, and eventually establish a functioning grain stabilization organization under the tutelage of SONIMEX. Once this point has been reached, the program can be gradually extended to other regions.

- That the location of the storage facilities be reconsidered. The present team feels that Nema, Aroun, Kiffa, Kaedi (using existing facilities), Boghe, and Rosso conform better to areas of production

and consumption, transportation routes, and administrative centers than some of the sites recommended in the earlier reports.

- That the capacity of the storage to be constructed be increased to 1,500 MT each, and that existing storage at Kaedi and Selibaby be renovated, for a total initial capacity of 9,200 MT.

- That flat storage warehouses of the type recently constructed by SONIMEX in Nema and Aioun, reinforced and adapted to grain storage either in bulk or in sacks, be substituted for the recommended subterranean, hermetic silos.

The team makes the latter recommendation for several reasons. First, the hermetically sealed silos rely for their efficacy on the maintenance of the seal. They were recommended on the assumption that disaster-relief grain would remain sealed for periods of 2 to 3 years, until it was needed during a serious drought when shortages often reach to 30,000 or more tons. We feel, however, that, given a storage capacity of 5,500 to 9,200 tons and the dimensions of shortages even in normal years, grain would move in and out of these silos every year. It would be difficult, therefore, to maintain the seal. Furthermore, experience with this type of construction in Argentina has shown that, given normal wear and tear on the structures, the seal is difficult to maintain after the facility has been used a few years.

Secondly, equipment for discharging underground silos is more complicated and difficult to maintain than equipment for flat storage. A breakdown would present serious problems, whereas flat storage could be handled with manual labor.

Another reason for this recommendation is that costs of both types of construction are approximately equal (international at $60 per ton) and, in the event of a breakdown in the program, the flat type warehouse would be immediately adjustable to other uses. Underground silos would remain as unused monuments to a failed program.

Operationally, in a grain stabilization program, the action agency, probably SONIMEX,would stock all structures with donated grain and use these stocks for disaster relief while the market stabilization effort became operational. One region would be chosen as a pilot region for market stabilization. In this region the major storage facility would be stocked with millet purchased locally through farmer production and marketing cooperatives at prices announced by SONIMEX at the beginning of the cropping season. These prices would be compatible with world market and regional prices and with the specific economic situations of the Mauritanian market. SONIMEX would stay on the market throughout the year and price would be increased with time. Prices would in all cases cover costs of the marketing organization. Stored grain would be placed on the market by SONIMEX to relieve upward pressure on consumer prices and to relieve area shortages, or when called upon and to the extent available for disaster relief. In cases where prices are subsidized for purposes of disaster relief, SONIMEX will be reimbursed by the Government of Mauritania for its marketing costs.

This pilot marketing program will be evaluated and revised as experience deems it desirable, and will be extended to other regions over an established time schedule. In 10 years it is anticipated all warehouses will be stocked with grain purchased under such a market stabilization program rather than with donated grain. A production increasing program including both research field testing and extension and credit aspects will be launched concurrently in the pilot region.

REGIONAL AND PROJECT GOALS

SECTOR GOAL

The sector goal, measurements of goal achievement, and assumptions about goal achievement are documented in the appropriate section of the project PROP.

PROJECT GOALS - MAURITANIAN COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

The project goals for the Mauritanian component are:

1. To assist the Mauritanian Government develop a grain marketing policy and a long term supply-management and storage plan, both for disaster relief and market stabilization, including facility requirements and specifications.

2. To assist the Mauritanian Government develop an investment schedule of program inputs which will be required to support a viable program of supply management.

3. To assist GOM strengthen its research and extension programs in cereal grain production and coordinate them with the stabilization effort.

4. To assist GOM identify, collect, and evaluate the data required to develop an effective food grain program and ascertain the economic social and political results of alternative policies.

5. To assist GOM establish a grain marketing organization capable of effectively managing a stabilization program, including financial, accounting and inventory management, procurement, distribution, and transport practices.

6. To assist GOM develop the physical infrastructure necessary to a supply management program.

7. To assist GOM develop and complement effective training for all levels of management and technical personnel.

8. To achieve in Mauritania a program of food grain stabilization which will be compatible with the regional grain stabilization program of OMVS, and with the programs of member states.

9. Through the medium of OMVS to re-establish and regularize millet and sorghum commerce among member states.

OUTPUTS EXPECTED AT THE END OF PROJECT

Given the amount that needs to be done to establish an effective program in Mauritania, 3 years is not sufficient to obtain the overall sector goal stated in the project paper. A minimum of 10 years will be required to achieve an efficiently functioning food grain marketing program.

Substantial results indicative of progress can be achieved in the first 3 years of the project, however. GOM will have developed a long-term supply management policy and program of action. Also the Mauritanian Government will have developed an investment schedule of program inputs, including a priority sequence of investments for the supporting marketing infrastructure. An organizational structure, regulations, rules of procedure, and policy will have been developed for a grain stabilization organization.

Three of the five proposed storage structures will have been completed and action will be underway to complete the remaining two structures not later than the fourth year of the project. The existing storage facilities at Kaedi and Selibaby will also have been rehabilitated. At least two of the new or rehabilitated structures will be filled with donated grain and functioning as disaster reserve storage under the management of SONIMEX and local authorities.

A managerial and technical cadre will have been chosen and trained for central management and one regional price stabilization operation. The trained cadre will be in place and operational under the tutelage of SONIMEX in one selected region to conduct a market stabilization program beginning with the 1975 crop year.

An increased program of cereals research will have been undertaken at Kaedi, and at least 2 years of field trial results in higher yielding varieties, improved cultural practices, and fertilization will have been obtained and analyzed for the selected pilot region. A plan and schedule will have been developed and implementation would be underway for extending field testing to other regions.

A study will have been completed and implementation will have started on strengthening the extension program in the pilot region. Minimally this strengthening would include:

- Selection of well-trained agents capable of relating to the peasant population and motivated to work in the countryside.
- Retraining agents in skills required for the cereals programs.
- Increased materiel support.
- A demonstration plan, implementation starting no later than the 1974 crop year.
- A cooperative development plan, implementation starting no later than the second year of project.

Regional trade in cereal grain, particularly between Mali and Mauritania, will have been reestablished and regularized through the efforts of OMVS.

BASIC ASSUMPTIONS ABOUT OUTPUTS

Several basic assumptions are made regarding outputs. One is that the planning, implementation, and time phasing of the project will be allowed considerable flexibility subject to continuing review and revision as seen necessary by changed conditions, new or more completely developed information, accelerated inputs from other sources, development of more promising alternatives, improved technology, etc.

Another assumption is that the Government of Mauritania, through its officials, will continue to show an active interest in the project throughout its operation and will express this interest to all action agencies involved through timely policy, personnel, and budget support.

It is assumed that international assistance agencies already working in cereals development will continue their support, and that they will coordinate their efforts. In particular, FED will maintain its interest in furnishing storage facilities and PAM will continue to supply donated grain to the disaster relief program.

Also, all marketing policies developed and implemented within the context of the Mauritania project will be in harmony with the overall policies and goals of OMVS, and GOM will continue to support this regional harmony. The grain marketing organization developed in Mauritania will not seek monopoly control of the market, but will rely on and, in fact, assist in facilitating, under proper controls, the role of private dealers on the market.

STATEMENT OF PROJECT INPUTS

PERSONNEL

Advisory personnel required for the Mauritania component of the OMVS Regional Grain Stabilization Project and their major responsibilities are indicated below.

Regional Grain Marketing Advisor

USAID will provide, on a regional basis, one grain marketing advisor for OMVS. His primary area of expertise will be grain market policy and market development (including pricing, market analysis, policy formulation, and evaluation). This advisor will:

a. Serve as team leader of all advisors funded under this project and will coordinate all of their activities.

b. Be responsible for working with the governments of the cooperating countries in formulating market policies and procedures which are consistent and regionally compatible.

Man-months devoted to each country will depend on country program requirements. Base of operations will be Dakar. The advisor will be responsible for the following activities:

a. Advise the appropriate GOM agencies on matters of market policy formulation.

b. Assist the appropriate GOM agencies to formulate a comprehensive market development plan, including organizational structure, methods of financing, and operational procedures.

c. Assist appropriate GOM agencies develop present and anticipated program costs and utilize to the maximum extent the resources of the private sector toward an efficient stabilization program.

d. Assist appropriate GOM agencies determine the kinds of data required to formulate market policy, and develop a system for the collection and analysis of aggregate data.

e. Assist appropriate GOM agencies carry out market surveys, project commodity supply and demand schedules, and prepare long-term storage and handling facility plans.

f. Assist in the documentation and presentation of development loan justifications and backup data for the grain marketing program.

g. Coordinate Mauritania policy, planning, and implementation activities with those of other member countries and the regional association.

h. In collaboration with the Mauritanian grain marketing "zreualut" and those of the other OMVS countries and ITA, develop a regional grain standard.

i. In cooperation with all regional "zreualuts" and their organizations develop a system of regional crop reports and analysis.

Grain Marketing Specialist

USAID will provide one grain marketing specialist qualified and experienced in all managerial and technical aspects of grain marketing and storage. His primary responsibility will be to work with the Government of Mauritania and SONIMEX on program organization, management record systems, inventory control, quality control, development of long-term warehousing requirements, field organization, and managerial and technical training. Base of operations will be Nouakchott.

The grain marketing specialist in Mauritania will have the following responsibilities:

a. Serve as general marketing advisor to the management of SONIMEX.

b. Assist SONIMEX develop a grain commercialization section within its organizational structure.

c. Assist SONIMEX develop a set of operational plans and policies for this section.

d. Assist SONIMEX develop manpower requirements and a training plan for its grain commercialization personnel.

e. Assist SONIMEX develop a system of inventory management, records control, storage, handling, transport, and cost analysis procedures.

f. Assist SONIMEX develop storage facility designs as well as location and storage requirements projections, in collaboration with the regional grain marketing advisor and, as required, engineering consultants.

g. Assist SONIMEX plan, conduct, and evaluate market surveys and other data acquisition procedures.

h. Assist SONIMEX select a pilot grain stabilization region, develop and implement a grain stabilization plan in that region, analyze and evaluate the effectiveness of this pilot effort, and, using this experience, plan the expansion of the pilot program into other regions.

i. Assist SONIMEX plan and implement an effective insect, rodent, and pest control system in their grain storage.

j. Assist SONIMEX and the extension services plan and implement the formation of farmer production and marketing cooperatives in the pilot region and, on the basis of this experience, plan and implement expansion of the cooperative movement to other regions of the country.

k. Assist SONIMEX develop a set of grain standards and a system of crop reporting that conforms to an OMVS regional standard.

Technical Assistance to the Production Program

The guidelines available to the study team indicate that five project-supported personnel are the maximum, given the resources available. Considering program priorities we feel these should be a regional marketing advisor, three marketing specialists with the member country marketing organizations, and the agronomist already specifically committed to the Mali production program. We also feel, however, that the Mauritania program requires a production effort, and this effort will necessitate some technical assistance in both research and extension. We suggest that it might be made available from one or more of the following sources:

a. The project manager, who is a highly trained and experienced agronomist.

b. The agronomist presently in Dakar working on the major cereals project.

c. Short-term assistance from the project agronomist assigned to Mali.

d. Short-term consultants.

Consultant Services

USAID will provide, in addition to the project-funded technical advisors already described, short-term consultants as the program requires and as mutually agreed upon by the donor and donee. It is anticipated that additional consultant assistance may be required in the fields of engineering design, crop production, and transportation. For purposes of budget calculations, a total of 10 months consulting assistance per year (2 months per specialist assigned to the project) to meet all regional requirements have been provided.

TRAINING

Orientation

It is recommended that the Minister of Commerce or his representative and the SONIMEX staff member named to head the grain stabilization section make a minimum 10-day visit to Niger to study the management and operation of the Office of Productivity Vinners.

Executive Development

The following is considered the minimum level of participant training required under the project. Such training should be planned to commence as soon as the Government of Mauritania has assigned personnel to the designated positions and they can be taught English. All training would be very carefully specified by the regional marketing advisor and would be specifically tailored to the past experience and training of each candidate. Resident academic training would be conducted at the Food and Feed Grain Institute at Kansas State University.

a. Director or Deputy Director, Grain Stabilization Program. A 5-month resident program including 3 months grain marketing, 1 month cooperative credit, and 1 month warehousing and handling. The academic training would ideally be concluded with a 1-month field assignment to a large grain cooperative such as the Far-Mar-Co in Kansas City or the Arkansas Rice Producers Cooperative.

b. Chief, Grain Sanitation Program. The Mauritanian responsible for the sanitation program should receive a 3-month academic training program in all aspects of insect, rodent, fungus, mould, and other pest control at Kansas State. This should include substantial opportunity to observe sanitation programs in operation in the field.

c. Superintendent, Pilot Grain Storage Facility. This official should be provided with a minimum 3 months of resident training in warehousing management and techniques at Kansas State, plus a 1-month opportunity for on-the-job training at a comparable grain storage facility in the United States.

It is anticipated that all participants will be given English language training if needed. If this is not feasible, training will be arranged through ITA for comparable training either at ITA or in a French-speaking third country.

Middle Management and Technician-Level Training

It is difficult at this point to specify the amount of middle management and technician-level training which will have to be conducted, but given that most personnel involved with the program will require periodic retraining, it is a considerable amount. An excellent facility with some experience in the field already exists in Dakar (ITA). The Director of ITA has indicated a strong interest in active participation in the project. Attention must first be given to providing ITA with working copies of warehousing equipment to be used, some lab equipment, and course outlines. Concurrently the grain marketing specialist, in collaboration with the SONIMEX director of grain marketing, the regional advisor, and the ITA faculty, can develop and project specific training needs. Training will need to include units on procurement, receiving and handling, transport, record-keeping and accounting, grain handling, sanitation, fumigation, grain standards, care and condition of grain storage techniques, and operation and maintenance of handling equipment.

INFRASTRUCTURE

Storage facilities at three levels are critical to the success of a grain marketing program--major central facilities either in production or consumption areas, buying point facilities, and on-the-farm storage.

Major Central Storage

We recommend an intermediate goal (5 years) of five new facilities, 1,500 MT capacity each, and two rehabilitated facilities with a capacity of 1,700 MT, for a total storage capacity of 9,200 MT. This is short of the capacity needed for a fully effective disaster relief and price stabilization program, but large enough to be reasonably effective and to be within resource limitations. All warehouses should be constructed and put into operation as disaster relief storage within 5 years, except one where the disaster relief objective will be supplemented by a pilot price stabilization program.

The five new facilities will be of concrete construction 35 feet in width, 130 feet in length, and 23 feet in height at the eaves. Each will be divided into eight compartments with individual capacities of 187.5 MT when filled with bulk grain to a height of 15 feet. All walls must be grain-bearing to a height of 20 feet. Each bin must be gas-tight but need not be hermetically sealed. Additional construction details are contained in Appendix A. Cost data furnished by the Mauritanian Government indicates this type of storage facility can be built for approximately $60 per metric ton.

The team recommends that the grain storage facilities at Kaedi and Selibaby be rehabilitated. Recommended procedures for accomplishing this, including equipment to be used, are contained in Appendix A.

Buying Point Storage

The team suggests that viable cooperatives be developed to participate in both the production and commercialization aspects of the grain program. They could serve as agents for selling their members' grain either to SONIMEX or

other dealers at official prices. To function in this manner they must be equipped with three to five of these silos, each with a capacity of approximately 3 tons. The site and labor plus a minimum of 10 percent of the out-of-pocket costs for construction of these silos should be supplied by the co-op. Steel and cement would be furnished by the Government of Mauritania, either by grant or long-term loan to the co-op. As an adjunct to the program, several of these cooperatives could be furnished with a small threshing machine to test the demand for that service on custom basis.

We feel that at least 40 cooperatives would be necessary to support one major facility, and that these could be provided at a cost to the state of approximately $50 per metric ton.

The team suggests that the development of viable cooperatives capable of active participation in the production and marketing aspects of this project may be the most difficult part of the entire grain stabilization effort. We also feel it to be extremely important that the possibilities for cooperative formation and participation be tested in the pilot program.

On-the-Farm-Storage

With the notable exception of the Serikole, Mauritanians do not store grain on the head in farm granaries. This method of storage is, however, technically feasible and such storage facilities are probably the cheapest available, being built with farm labor and reasonably accessible inexpensive materials. The team suggests that an active component of the pilot region program be the encouragement of the construction and use of farm granaries. As an essential part of this program, the research organization should undertake a study of the economic and social factors which encourage sale or storage on the part of family decision-makers.

WORKING CAPITAL

Assuming that SONIMEX's costs for handling grain approach those of ONCAD in Senegal, and that the organization will handle approximately 1,500 MT when the pilot program is in full operation, the grain buying program itself will require a working capital of $180,000 in the pilot operation. This will increase to a little over $1 million as the program moves to other regions.

BASIC ASSUMPTIONS ABOUT PROJECT INPUTS

The following assumptions are made regarding project inputs:

- That AID can recruit personnel in a timely manner who have the required qualifications of education and experience and who speak French at a minimum level of FSI-3.

- That any AID personnel recruited to the program who do not speak French at a minimum level of FSI-3 will receive training to arrive at that level before they are assigned to post.

- That AID personnel assigned to the project not only be qualified technically and linguistically, but also be capable of functioning effectively in a different environment and, above all, be

able to establish effective working relationships and rapport with their Mauritanian counterparts and co-workers.

- That the Government of Mauritania and its action agencies will assign capable, active, interested personnel to all levels of the project; will make them available for training; and will assign them to the responsibilities for which they have been trained.

- That the action agencies of the Government of Mauritania will give wholehearted support to an effective program; that they will develop effective mechanisms, both official and informal, for close cooperation and collaboration; and that they will offer the opportunity for close working relationships and support to AID project personnel.

- That a small pool of capable, experienced management personnel exists within the SONIMEX cadre, and some of them will be assigned to the grain stabilization organization and programmed into executive development programs at an early date.

- That a substantial training capability for middle management and technical personnel already exists within the Institute of Food Technology at Dakar, and that it will be used to the maximum extent possible in training SONIMEX personnel.

- That, although the little work that has been done in the past in cooperative development in Mauritania has not been entirely successful, this failure has been due to planning and operational difficulties rather than the inability of the Mauritanian peasant to understand or to function within cooperative principles.

- That the Agricultural Services will be interested in both cooperative development and research and extension efforts to increase production in the pilot region; will lend their resources to this effort; and will cooperate closely with the grain marketing organization to plan and implement the project.

- That grant or loan financing on favorable terms will be available for infrastructure construction.

- That sufficient working capital can be made available for a grain buying program on the scale recommended.

BUDGET

PERSONNEL

AID will assign one grain marketing specialist to the program in Mauritania. Service of an AID grain marketing advisor will also be available to the Mauritania program, but budget for this person has been included under the Senegalese project design. We have assumed that the qualified grain marketing specialist who will work in Mauritania can be recruited and put on the job by June 1973.

Grain Marketing Specialist, Mauritania

	FY 1973	FY 1974	FY 1975
Salary	--	$28,000	$30,000
Language	$5,000	--	--
Travel to post	--	4,000	--
Education	--	3,000	3,000
Housing	--	8,000	8,000
Differential	--	7,000	7,500
Overhead	--	--	--
Per diem (100 days @ $25/day)	--	2,500	2,500
Equipment -			
Vehicle (hand power)	--	5,500	500
Professional equipment	--	500	200
On-the-job travel -			
Surface (10,000 mi. @ $.25)	--	2,500	2,500
Air	--	1,000	1,000
	$5,000	$62,000	$55,200

Assistance to the Production Program

It is not possible to develop a budget at this point, particularly since assistance to research and extension needed by the respective services to establish an effective pilot program in one region must be much more closely defined. Based on estimates developed for Mali, a tentative guideline might be:

FY 1973	FY 1974	FY 1975
$20,000	$30,000	$30,000

Consultation Services, Mauritania *

FY 1973	FY 1974	FY 1975
--	$10,000	$10,000

*Calculated on the basis of 2 months per staff member per year at the rate of $3,750 per month (salary plus per diem) plus travel.

TRAINING

Orientation

Trip of not more than 2 weeks for two officials to Niger, per diem plus travel, would cost $1,700 during FY 73.

Executive Development

Based on four participants, a total of 15 months training at Kansas State, with provision for educational travel and on-the-job training in the United States, would cost:

FY 1973	FY 1974	FY 1975
$4,000	$6,600	$3,500

This assumes training for one program director, FY 73; one warehouse supervisor and one sanitation supervisor in FY 74; and one warehouse supervisor in FY 75.

Middle Management and Technician Training

	FY 1973	FY 1974	FY 1975
Middle management Tng. at $180/trainee week, including room, board, and transportation.....	$3,600	$18,000	$18,000
Technician Tng. at $180/trainee week, including room, board, and transportation.....	3,600	18,000	18,000

INFRASTRUCTURE

Major Facilities

Included are 7,500 MT of new storage at approximately $60 per MT over a period of 5 years, plus rehabilitation and equipment of facilities at Kaedi and Selibaby at a total cost of $25,000.

	FY 1973	FY 1974	FY 1975	FY 1976-77
New facilities *.....	$50,000	$100,000	$100,000	$200,000
Rehabilitation & equipment.....	10,000	15,000	--	--

*To be provided through an FED loan or grant.

Buying Level Facilities

Equipping 40 cooperatives with 12 to 15 tons of storage capacity in Bambey, IRAT type silos at an estimated cost of $50 per metric ton. The team estimates that not over 30 of these cooperatives can be organized, equipped, and functioning within the first 3 years of the project.

FY 1973	FY 1974	FY 1975
$5,000	$15,000	$25,000

APPENDIX A - MARKETING

Since independence and possibly throughout its long history, Mauritania has been a deficient grain producing area. The GOM wishes to safeguard its people from the ravages of hunger and also prevent them from becoming victims of high prices demanded by speculators during periods of grain shortage. There is complete accord within the government on the need for a reserve of food grain strategically stored throughout the country plus a grain stabilization program to foster commercialization.

ACTION AGENCY

There exists no agency within the government responsible for regulation or actual marketing of grain. The private sector is fragmented into many small dealers who handle general merchandise; there are no dealers who handle only grain. There exists no credit structure to finance grain marketing, although many private speculators will extend credit in kind or food to the farming community.

There is, however, a quasi-private trading company, SONIMEX, that has a monopoly on imported sugar, rice, and other imported items. This company also handles all donation grain received from FED, AID, and other international relief agencies. The relief grain is not distributed to the people by SONIMEX but, rather, delivered to the government agency making the individual distribution or sold to local merchants. This company does have a good internal structure -- management, accounting, communication, traffic control, and storage facilities. They are successful in their handling of rice and sugar at the wholesale levels. Also they are exporters of gum arabic.

RESERVE STOCKS

One department of the government should be given total responsibility for supervising SONIMEX activities on the allocation, transportation, handling, and storage of all reserve stocks.

The storage facilities for the reserve stocks should be owned by the government and leased to SONIMEX for a term of years. The government should reimburse SONIMEX for all direct freight charges plus a markup of 3 to 5 percent. They should be paid a fair and reasonable handling, preservation, and storage charge based on quantity handled and length of time in store.

Handling (i.e., in and out) costs should be based on tonnage handled and any treatments for preservation or conditioning the grain,while storage should be on tonnage times the number of days or months the stock remained on storage. SONIMEX should not be required to make distribution to the public. They would only have to deliver from storage to some government relief agency or to retail merchants.

The company should not have the responsibility of determining when distribution of reserve stocks should be made. The company should be held financially responsible for quality and quantity delivered from the reserve stock.

The reserve stock should be weighed into each storage facility. SONIMEX should be allowed half of 1 percent weight loss each month for the first year, and a third of 1 percent per month for the second year. The third year the original stock is held in store the weight loss should be a sixth of 1 percent per month. Should the company be required to redeliver the entire reserve stock at the end of the third year, they would be required to deliver only 88 percent of the original weight received. If the weight loss is greater than this, the company would have to pay the government the difference at the market value of the commodity at the location where the loss occured.

COMMERCIALIZATION

The GOM should rehabilitate the concrete elevator at Kaedi and the steel tanks at Selibaby. SONIMEX should be appointed as an agent of the GOM to operate both elevators as a market and public warehouse. As agents of GOM the company would not be the owner of grain purchased nor would they be risking their own working capital or net worth.

The GOM, through its agent, SONIMEX, should offer a ready market at a reasonable price for all grain delivered to the storage facilities. They should also be willing to sell at the wholesale level at a reasonable price. Also, producers who sold their grain to these facilities should be preferred customers and allowed to buy back, at the wholesale price, up to half the amount they originally sold. A producer should also be allowed to store his grain in these facilities rather than selling it. He should be returned a like quality and quantity less a weight loss discount of half of 1 percent per month of storage. As a depositor he would be required to pay a fair and reasonable handling and storage charge. The storage charge would include fire insurance, care and preservation of the grain, as well as a charge for the space occupied.

WORKING CAPITAL

SONIMEX should be on a 30 day billing cycle to the GOM, so would not need any additional working capital. The company would not be financing any grain inventory in its name at any time, either under the reserve or commercialization program. The billing cycle could be shortened during periods when large quantities of grain are being purchased under the commercialization program.

INVESTMENT CAPITAL

To build and equip the reserve stock storage facilities would cost an average of U.S. $60 per MT. This would not include the necessary laboratory and grain preservation equipment. The country is so large and travel is so difficult it is suggested that three sets of equipment be secured.

The building should be constructed in such a manner that, at a later date, conventional grain handling equipment may be added without conversion of the facilities. This in itself will add to the original cost, but, as commercialization of grain becomes a reality, the reserve facilities can become a conventional grain market.

Building five new reserve stock facilities with a total capacity of 7,500 MT would call for a capital expenditure of U.S. $400,000. This should be financed through a grant from FED. The rehabilitation of two existing elevators plus the laboratory and grain preservation equipment would cost $25,000. This should be financed with an AID grant.

TRAINING

The coordinator of the two programs for the GOM should take a 5-month grain marketing course at Kansas State. This course should include 3 months on marketing, transportation, and accounting; 1 month on grain handling and preservation; and 1 month of on-the-job training with one of the larger grain cooperatives. During this last month the student should be exposed to farm practices; on-farm storage; country point storage; and warehouse stock control, handling, and preservation. From this formal education and exposure to the grain trade, he should develop an understanding of grades and standards. With this training he should be able to direct and evaluate SONIMEX performance in handling both grain programs.

SONIMEX, in cooperation with the GOM, should pick the seven men who will manage the storage facilities, as well as the headquarters man who will be the general manager of both grain programs. These men should take a complete grain marketing course at ITA. This course should cover handling, care, conditioning, and preservation of grain, as well as stock control, maintenance and repair of equipment, grades and standards, sanitation, and rodent control. The success of both programs will depend on how well these men understand the need for a stored grain inspection program and the various corrective measures that can be taken to safeguard stored grain. They must completely understand bird and rodent control as well as how to detect insect infestation, molds or fungi growth, and out-of-condition grain. They must develop a deep understanding of preventive maintenance, including not only the need for an inspection and reporting program, but also use of fumigants, grain preservatives, insect-tight buildings, and fogs and sprays.

The men who will manage the two existing elevators should likewise be given some training in the functions of marketing. This training may also be obtained in the new and expanded grain handling courses given at ITA.

Second level management and maintenance men should also be sent to ITA for specialized courses needed to develop necessary skills.

The GOM coordinator who has gone to Kansas State should spend 10 days to 2 weeks at ITA evaluating the training received by the SONIMEX employees.

FACILITIES

Reserve Grain Program

The five buildings for the reserve grain program should be of identical construction, each with a capacity of 1,500 MT. Each building should be concrete, 35' wide, 130' long, and 23' high at the eaves. Each should be divided into eight compartments or bins with an individual capacity of 187.5 MT when

filled with bulk grain to a height of 15 feet. All walls must be grain bearing to a height of 20'. Each bin or compartment must be gas tight but need not be hermetically sealed.

The roof should be poured concrete so no cold joint exists between the upright wall and the roof. The roof should also be constructed so wheelbarrows or bulk grain carts may be pushed from one end to the other. Three feet square hatches should be built into the roof to give access to each bin or compartment. These hatches should have gas tight seals, be located 6' from the center wall, and give access to a ladder constructed in the bin walls. These hatches could be used for inspections, fumigation, and filling the bins with bulk grain.

Each bin or compartment should communicate with an adjacent compartment through a doorway 4.75' by 7.5'. There should be a sliding door constructed of 3/4" plywood. The doors should open and close by sliding up or down on a track or guide. Each interior doorway should have two sliding doors, one for each compartment wall.

When the bin is filled with bulk grain, the weight of the grain on the door will make a gas tight seal. There should be at least 5 sq. feet of ventilation area in the outside wall of each bin; this opening would be screened and have a gas tight shutter that can be closed. There should be a gravity ventilation stack 24" in diameter serving each bin; this too should be screened and have a gas tight damper built in.

At one end of the building there should be a manually powered elevator equipped with a bulk grain hopper for delivery of grain to the hopper on the roof.

Existing Elevators

KAEDI ELEVATOR

The concrete elevator at Kaedi should be returned to service as storage for bulk grain through utilization of the simplest type of mechanization. The facility must be completely cleaned and all existing parts of the old pneumatic system removed. All of the pneumatic delivery pipes, flanges, and elbows should be saved, however, for possible use when more efficient mechanical handling equipment is needed in the future.

Two manually-powered freight elevators should be installed at the receiving end of the elevators. These freight elevators should be equipped with a bulk, self-cleaning hopper to receive the grain from a pit or hopper at ground floor level and transport it up to a receiving hopper at the bin top level. The bulk grain would be held in this upper hopper at the bin top level until it was allowed to flow by gravity to wheelbarrow or bulk grain carts for delivery to the individual bins. Each bin is now equipped with a discharge valve or gate that can be converted to a sacking off spout. The bulk grain can then be sacked as it is removed from the individual bins.

The manually powered freight elevator consists of a platform set between vertical guide rails that are matched with guides on the frame of the elevator

platform. The elevator platform is connected with two sets of counter-weights that run on the outside of the guide rails. The lift or power train of the elevator consists of one pulley 4' in diameter over which runs a 1-1/2 or 2 inch diameter rope drive. This rope runs from the pulley down the elevator shaft and returns to the drive pulley, forming a continuous rope drive. The pulley is connected to a steel shaft 2-1/2 or 3" in diameter, to which is attached the wire rope that is attached to the elevator platform. Pulling on the continuous rope drive by hand turns the pulley, which then turns the shaft, winding up the wire rope attached to the elevator platform, causing it to move upward. (See elevator example in Appendix D.)

The elevator shaft must extend through the ground floor level to a depth sufficient for the elevator hopper to be below the level of the loading hopper. The loading hopper should be at floor level so the full sacks need not be picked up but, rather, emptied at floor level into the hopper. The elevator shaft extends above the bin floor so the hopper on the elevator will empty by gravity into the hopper of the bin top level, from which the wheelbarrow or grain carts are filled by gravity.

After experience has been gained in elevator operation and men have been trained in handling conventional handling equipment at ITA, the elevator could be converted to standard handling equipment. After 5 years training and experience, two bucket legs, one overhead screw conveyor, and two screw conveyors for taking the grain from the tanks should be added. A cleaner, automatic scales, truck pit, and load out equipment should be added.

SELIBABY ELEVATOR

This is a small, four steel tank elevator with total capacity of 400 MT. The facility has not been used since 1955; hence, the handling equipment is in disrepair.

No action should be taken on this facility until the elevator at Kaedi has been in operation for one crop year. Then, the manager of the Kaedi facility and the manager-to-be of the Selibaby facility, who will both have attended the entire grain handling course at ITA under direction of American agricultural engineers based at Dakar, should be able to make the necessary repairs to put this plant into physical operation.

This operation may require the help of a TDY agricultural engineer for 6 weeks after the needed repair parts have been delivered to Selibaby.

Farm Storage

The producers should be encouraged to continue storing their grain on the cob or head in the traditional manner. The agricultural agents from Selibaby and Kaedi should be sent to ITA for a course in care and preservation of stored grain. From this training they could make marked improvements in the traditional village storage methods.

Co-op Level

At the co-op level, IRAT-type concrete tanks should be built. The construction of several of these tanks at the co-op level could be the uniting factor so necessary for a successful co-op. The village co-op member should see at once the added fire protection offered by these concrete tanks.

The co-op member should be required to furnish all labor and pay at least 10 percent of the capital expenditure required to build the tanks. The remaining 90 percent should be a loan from GOM.

GRAIN STANDARDS AND INSPECTION SERVICE

A simple grain standard should be developed in cooperation with ITA. This standard need not have the same grading standards as Senegal or Mali. However, its end objective should be to have a standard that is common through all of West Africa. While standards do not set grain prices, they establish understandable criteria on which value may be based. With acceptable standards also come market discounts and premiums. It is no longer necessary for the buyer to view every sack he buys once standards are accepted by the buyer and the seller.

SANITATION STANDARDS INSPECTION PROGRAM

In cooperation with ITA, sanitation standards should be drawn up for both the reserve grain and commercialization programs. Standards should be tight, as some of this grain may not be needed for a period of years.

Along with the standards, a reporting and inspection system should be established.

Each bin containing reserve stock grain should be inspected each month for infestation, conditions, etc. Samples should be drawn from five different locations within the bin and at various depths. Each probe sample should be identified and placed in a moisture proof grain can. The next day the sample would be run through a moisture meter and the moisture recorded on the inspection report. Temperature should also be taken at five different locations in each bin, at two depths. These temperatures would be recorded on the inspection report.

One copy of this inspection report goes to the GOM coordinator; one copy to the SONIMEX grain manager; and one to the manager of the facility where the inspection was performed. A single inspection report is usually of little value as it only reflects the condition of the commodity for an instance of time; however, when compared to several prior reports, it becomes a continuing history of the condition of the individual bin of grain. From this information it is often possible to project the continued storage life of the commodity. From these reports corrective action can be ordered and the next monthly report will give an evaluation of the corrective action taken.

This inspection program and the evaluation of the reports and the corrective action taken could and will be the determining factor as to whether the reserve grain program is a success or failure.

The sanitation program outlined in pages 209 through 219 of "A Study and Plan for Regional Grain Stabilization in West Africa" by Kansas State University, dated December 1970, is made a part of this report in its entirety. These pages are reproduced in Appendix C.

MARKET PRICES

Reserve Grain Stocks

With 7,500 MT of grain on long term storage, even under the best conditions, some of this grain will no doubt go out of condition. Should it appear to the facility manager or the general manager of the grain program for SONIMEX that an individual bin of grain is going out of condition, they should recommend to the GOM grain coordinator that the grain be sold.

This grain should be sold while it still has most of its food value remaining. The price should be just below the market price so the grain will move rapidly into the market place and be consumed.

The sign of a good warehouse manager is one who knows he has done all that is possible to safeguard the condition of the grain but, when it starts going out of condition, disposes of it while it still has food value. By so doing he will recover nearly 100 percent of the market value of the grain. Such conditions call for prompt action on the part of the grain manager of SONIMEX and the responsible official of the GOM.

The following is based on the conclusion that GOM has the authority to sell the reserve stocks when an emergency develops within the country's food chain.

With continuing review of crop reports, imported grain, and weather conditions, augmented by direct reports from responsible officials in the field, GOM should know several months prior to the existence of an actual food shortage. When the price has risen to 60 CFA per kg., the GOM should offer an undisclosed amount of grain at 50 CFA per kg. until the market reacts with lower prices to the consumer. GOM should then stop sales until the market price has again risen to 60 CFA per kg.

With this unannounced movement in and out of the market, GOM should be able to control prices and still force all of the speculators to sell their remaining stocks at or near a reasonable price.

A reserve stock of 7,500 MT is about 5 percent of the annual consumption. If GOM handed out the grain free whenever a serious shortage developed, the speculators would just hold their stock off the market for 2 weeks and the GOM supply would be exhausted. With the end of the GOM supply of reserve stock, the speculators would be free to enter the market at whatever price the traffic would bear. However, if the GOM enters the market with an undisclosed amount to sell at 10-15 percent below that market, the speculators would be forced to follow the market, hoping to sell as much as possible at even the reduced price. This would tend to utilize all resources of the country to move grain from other sources before GOM decided to further reduce that price. When the free

market reaches the government price, GOM should withdraw from the market until the free market again started up; they could then re-enter the market at a somewhat lower price again.

The prices used in the above are examples only. GOM might wish to enter before the price advanced to 60 CFA. The great danger is that GOM would want to utilize all reserve stock some weeks or months before harvest and, in so doing, would let the speculators set the free market price.

Commercialization

GOM should set and announce a basic price for grain before harvest. This basic price should be set after review of the market price at harvest during the past 5 years. This price need not be the 5 year average; however, the 5 year average should be used as a guide and tempered by current weather and harvest conditions.

The basic price should be just under the free market price. GOM would have the right and duty to increase this price if necessary, but not the right to reduce it below the announced basic price.

Every producer in the area should know that he can deliver his grain to the Kaedi elevator and receive at least the basic price in cash the same day delivery is made.

The base price should be advanced by a half CFA per month; i.e., if a base price of 20 CFA was being paid at harvest, the next month 20-1/2 CFA should be paid, then 21 CFA, etc. This would give the producer an incentive to retain all or part of his saleable crop in farm storage for later sales. However, should the free market advance at a much more rapid rate than the half CFA per month, GOM must follow the market until the price doubles that paid at harvest. Then, they should start selling at somewhat below the market. This action should have an immediate effect on the free market; for this reason, it is important that they acquire some inventory shortly after harvest, even if they have to pay somewhat over the free market. This will require fast and open communication between the warehouse manager, the grain manager of SONIMEX, and the grain coordinator of GOM to react to the market and to adjust the price being paid at the elevator to the market.

SHARE OF THE MARKET

Responsible GOM officials estimated production at about 100,000 tons and imports 25-50,000 MT. What percent of the production is marketed would not even be estimated by the same officials.

Possibly less than 10 percent of local production reaches the free market. The chief immediate benefit of a free market would be the breaking of the debt circle where the producers sell their grain to local dealers on credit before harvest for 10-15 CFA per kg. and receive food or grain at an inflated high price; i.e., some producers sell their grain before harvest at 10-15 CFA to actually buy grain at 50-60 CFA per kg.

The first year the Kaedi elevator is in operation may result in the purchase of only 3-400 MT. However, this would be a start and would show the producers they could receive the market price in cash and then have the opportunity to buy back at a reasonable price at a later date.

With the development of local co-op receiving stations, the elevator should be handling 2,000 MT within 5 years.

APPENDIX B: PRODUCTION

There are opportunities for increasing grain sorghum and millet production in Mauritania. Even at world prices of approximately 12 CFA FOB foreign port or nearly 15 CFA at a local port of entry, there are many improved production techniques and practices that appear feasible and could be highly profitable.

The greatest opportunities for increasing production in Mauritania are along the Senegal River where it overflows its banks every year. The river terraces are broad, nearly level alluvial plains of fine textured soil. There are indications the bank along the brink of the river is slightly higher than the main part of the wide terrace plain.

However, the river apparently flows at an extremely slow velocity. In June 1972, at low flow, the depth in some places near Bogue was estimated to be about 3 feet. The flow was reported to be 200 liters/second. This would be insufficient to irrigate even a small part of the land suitable for irrigation. Also, it was reported the Senegal River belonged to Senegal and, before much water can be applied to improve agriculture on the Mauritania side, it would be necessary to arrange some type of compact on water rights.

One difficulty of increasing production in the areas with greatest opportunities is that these areas are surplus producers and any additional production would tend to depress the grain price at harvest, making it lower than in the past unless an improved market system is established. The inelasticity of the market in Mauritania is almost beyond imagination. At times there is practically no market. There is no buyer with the necessary transportation or storage facilities to remove the surplus. The reported shift from a low price of 4 to 5 CFA/kilo to 80 CFA/kilo within the year must be corrected before a production program can be expected to succeed or should even be started, however.

In some of the deficit areas, namely Nema or Aioun, where the supply of grain seldom equals or exceeds the demand, the opportunities for increased production are more limited and hazardous. Here again, there are years when the harvest grain is far above the average and the price drops to a very low level; no buyer is large enough to be effective in stabilizing price. Many consumers in the area are nomads and storing large quantities of grain to meet their own needs for more than a short time cannot be expected. The movement of food is just an added burden and a 1 year supply is more than ample.

With this great fluctuation in production brought about by extreme differences in the weather and high cost of transportation to defict areas, it would not appear encouraging to suggest an extension production program at this time. At least there should be good evidence that recommended changes are almost sure to succeed. At present there are no results upon which recommendations can be formulated. This is especially true in the grain deficient areas. Unless it is possible to establish an assured, attractive price that will be paid for the grain at harvest, there is some question whether it would be wise to encourage the farmers to produce more than they need for their own use. Any addition would tend to make the merchant richer and the farmer poorer.

The price must be attractive enough to cause the cultivators of the land to either expand their operation to the more marginal areas or to apply more improved practices. Under present market structure and the high storage losses--reportedly, losses of farm-stored grain due to insects and rodents may be as much as 30 to 35 percent --there is little or no incentive to increase production.

QUESTION TO BE ANSWERED PRIOR TO INITIATING A CROP PRODUCTION PROGRAM

The team was not able to find any results of field trials or demonstrations in the grain deficient areas. According to the Insitut De Recherche Agronomique Tropicale (IRAT), no experiments or field trials have been made in the grain deficient areas in Mauritania. The same idea was expressed by the FAO representative working on Project 26, "Cooperative Regional Field Trials in West African Nations." Little can be demonstrated with reasonable assurance of success, then. It therefore seems logical to this team that the best approach would be to initiate some simple field trials of practices that appear most likely to result in profitable returns to the cultivator and increase grain production in most years.

One practice that appears to hold greatest promise is adjusting the planting rate to normal water supply. In grain deficient areas the normal yield is about 250 kilos/hectare. It has been the practice to plant 15 to 20 seeds in holes 150 cm. apart, thinning these to 3 to 5 plants per hole if and when they get around to it. These are more plants than recommended by IRAT even where the moisture supply is best. As a trial, the holes should be placed closer together, say 100 cm. or about 40 incres in each direction, to make better use of the water supply. All holes should be thinned to one plant per hole, or never more than two. This would be more in keeping with the recommended practice. This rate of planting would provide sufficient plants to far exceed the reported present yield of around 250 kilos per hectare.

There may be some questions about the low yield reported, as the average yield would be 364 kilos/hectare if we were to accept the calculated yields in the 1970 Report on the Conditions and Possibilities to Create in Republic Islamic of Mauritania a Regulative and a Reserve Stock of Sorgho, presented to the Government of Republic Islamic of Mauritania by the FAO/PAM mission consisting of R. di Furia, FAO, I. Pattison, FAO, and R. Pollaris, PAM. If we also accept the statements made by both farmers and government officials that the river terrace lands were producing between 400 and 500 kilos/hectare, then at least some of the less productive areas would be producing less than 300 kilos per hectare.

In all the trials we have been able to locate, there is every reason to believe early planting should be encouraged. Most results point to about a 2 percent decrease in yield for each day lost in planting. In every village, cultivators know it is important to plant as soon as possible after flooded land has dried sufficiently to work.

The present planting method is to dig a hole with a narrow bladed pick and then drop the seeds into the hole. In some places the farmer tries to scratch the surface lightly (3 to 5 cm. deep) to prevent crusting and reduce weed growth. There are a few three-tooth cultivators (tools) but not enough

for all farmers to use them. It takes animal power to pull the cultivator, which many of them do not have. Villagers reported one to two donkeys or a camel could provide the power, but many small farmers have neither. To expand this practice, animals would need to be rented or purchased and credit would need to be established to pay for this service.

There is one tool that was never mentioned that should be tried in a limited way; that is one of the simple hand jab corn planters that was in use about 50 years ago in the USA. If brought into the country, repair parts also need to be included. The soil may be too tight to use this type of planter successfully except on the sandy loams, but we believe this simple tool could hasten the planting operation.

Since there is every indication that it is very important to get this crop established as soon as possible and to make sure it is well established while there is a good moisture supply, the team recommends the use of a "starter fertilizer." We realize that fertilizer is expensive and it would mean the importation of an item not locally available; however, we are reasonably sure it is worth a try. From all observations and knowledge of similar experiences, we believe the fertilizer should be high in nitrogen and contain some phosphate. The team suggests that a 30-10-0 (Ammonium Phosphate Nitrate) or at least a 26-13-0 (Nitric Phosphate) be selected as the one to be tried the first time. It is not advisable to recommend or think of using a low grade fertilizer such as 14-7-7, which is recommended and in use in Senegal as well as a few places in Mauritania. The cost of transportation from port of entry (Rosso, Mauritania) to Nema is 30 CFA/kilo, the same as the cost of the fertilizer. This means 14-7-7 could not compete with a concentrated type even if it were free at the port of Rosso.

The present method of applying fertilizer is to broadcast it and then work it into the soil surface. We learned of only one tractor being used to work the fertilizer into the land, and that one was at Kaedi. With soils that have a high fixing power for phosphate and a lack of rainfall to carry the nitrates into the soil after the crops have been planted, it would be surprising to find a large increase from the use of fertilizer applied broadcast. This is <u>not</u> our recommended method of applying fertilizer to soil that is extremely low in both nitrogen and phosphate. Potassium is still a question, but we doubt that it is important in these soils as a "starter" fertilizer. The team therefore recommends that a high nitrogen-low phosphate fertilizer be tried at the rate of 10 kg./hectare applied in the hole with the seed at planting time. The rate of application may appear low, but this was used in the U.S. during the early days of fertilizing grain and found to produce increases in yields of corn from 200 to 300 kilos per hectare. Even at half this increase, this fertilizer would reduce grain import costs 10 to 15 percent.

From reports by farmers in the villages, we concluded most sorghum and millets are very tall (12 to 15 feet). This means much of the water required to produce the plants has been used to produce stalks rather than grain. Present varieties are mixtures of seed. We observed this as we examined the granaries and farm store houses. Orange or brown seeded sorghum is not liked by the people. They have the idea that, if they mix white and orange together, they can fool the birds; but, there is some question as to whether this is of

any importance. In one place we found a small plot near the river where the heads had been covered with rags to prevent the bird damage. If birds cannot be controlled by other means, bagging the heads might be worth a trial. But, if yields could be substantially increased by other improved practices, the children in the village could be more effective on chasing the birds out of the small area needed to be cultivated.

FIELD TRIALS RECOMMENDED

In light of these conditions, we would suggest small plot trials of the best white or yellow endosperm grain (not orange or brown), short, early, not day length affected, high-yielding variety recommended by IRAT, Bambey,Senegal.

We would recommend that four treatments be tried, with four replications at each trial. The plots should be laid out so each replication would be on or as near as possible to the same kind of soil and where the water stands about the same length of time. Each plot should be approximately 5 meters wide and about 40 meters long. The treatments are as follows:

(1) Farmers seed with the normal planting method.
(2) Farmers seed with method of planting + 1 gram (a 3-finger pinch) or granular 30-10-0 fertilizer dropped in the hole with the seed.
(3) Recommended seed planted in holes 1 x 1 meter and, after established, thinned to one plant per hole.
(4) Same as (3) but fertilizer added as in (2).

We suggest a 4 by 4 block design for the trials, with each treatment only once in each column. These trials should be established at the earliest possible date.

To avoid any possible adverse criticism of these trials, the farmer and land owner should be assured that, under no condition, will either suffer any loss due to the trials. Should there be loss, grain would be purchased and given to them to make up the difference. Any yield increases resulting from the trials would also go to the farmers and land owners for their cooperation. Since there will be 2 1/4 times as many holes to dig when the planting is 1 x 1 meter, the cultivator should also receive payment for his extra labor if the trials fail to increase yields sufficiently to properly reward the farmer and landlord.

A reduction in yield is unlikely, but any doubt about success should be eliminated from the beginning. No mention should be made of expected increases to either the farmer or land owner. These are trials only, and we are not trying to prove that they are using the wrong method or that we have a better one. It should be pointed out that we want to make these trials because we have hopes that one or more of the things we try will be something they will want to try again.

Each trial will require a very small amount of seed and fertilizer, not more than 1 kilo of each. In addition, the following items will be needed: a small spring scale, calibrated in kilos, for each cooperating agricultural agent so he can weigh the harvest; burlap bags, 100 kilo size, to hold the

harvested heads from each trial area; a small, inexpensive plastic rain gauge to measure rainfall at each village conducting the trials; and wet and dry bulb thermometers for each cooperating village.

Daily rainfall and temperature at sunrise, high noon, and sunset (taken on both wet and dry bulb thermometers) should be recorded. If it is possible to have a wind velocity gauge in an open area about 5 feet above ground level, wind velocity readings should also be recorded with the temperatures throughout the growing season. A simple pilot tube could be used to measure wind velocity. These data would be helpful in evaluating rate of transpiration and evaporation. Along with plant observations, they help determine rate of planting and whether additional plant populations would be beneficial. The number of heads (ears) produced and harvested on each plant should likewise be recorded, along with average weight per head. This would also give an idea as to best planting ratio.

Obtaining necessary equipment and supplies is relatively inexpensive and easy. The real problem is training people to do the work and then getting them to follow through to completion. Some type of incentive or reward should be provided for people who exceed the minimum requirements of job performance. Standards set for this reward should be such that 10 to 25 percent of the employees could reach them.

Production trials should start as soon as possible, as these should precede any widespread use of on-the-farm demonstrations. The main purpose of the field trials is to obtain information upon which to formulate demonstrations.

EVALUATING THE RESULTS

After the first year, the agronomist or technician assigned to this work should consult with research personnel in IRAT at Bambey and the yield trial officer of FAO to determine how the trials might be improved keeping in mind that the trials must remain simple and within resources of the farmer. This is no place for an in-depth research project. It must be kept practical, useful, and profitable to both farmer and landlord.

If near the end of growing season it can be easily seen that the trials will produce substantial yield improvements, an all out effort should be made to get important officials to see the results in the field before harvest. They should be photographed in the field and their comments should be broadcast and publicized. Officials should be assisted in every way possible to spread this information to other government officials who might be affected by or have influence on the actions taken by GOM. The use of the radio should be maximized. Promising results are of little value until they have been exploited by every means possible.

There is no question but what Mauritania could greatly increase production if it had modern equipment, trained people, irrigation, and all needed services at its disposal. But, this is impossible to think of at this time.

Mauritania expects to start research work on irrigated rice. We commend their efforts on this. Since the country imports 40,000 to 50,000 tons of rice annually, we would encourage them to proceed along this line. We know of no

better use of land suitable for irrigation under their present conditions. Even this change is going to require a great amount of training and far more cultivators (farmers) than presently employed in agriculture. Supervision of such an undertaking is almost beyond comprehension.

Since the change will probably take place slowly, though, we believe there are some other practices that should be tried in the surplus areas. For example, there is no question in our mind that the soil used for crops is extremely deficient in nitrogen, both total and available. The soil needs organic matter badly.

The livestock show every indication they are undernourished. The protein in their diet is at the subsistence level. The country would be far better off productively and financially with no more than half the present animal population. Far too much value has been placed on head count rather than returns from meat and milk. We understand it would take more than an act of government to reduce livestock numbers, so we believe a better feed source should be found which would improve both livestock and soil productivity.

Since most of the river terrace soils appear heavy textured, the legume-peanut does not seem advisable; therefore, we suggest a few trials of some African alfalfas, with seeding just as the water recedes from the land. Weeds may be the major problem if seeded broadcast. If this is the case, the alfalfa should be seeded in rows about 50 cm. apart and cultivated. Chickpeas might also be tried, but these may not have sufficient strength to penetrate the surface soil unless planted in holes and covered with sand. These legumes could furnish some of the needed nitrogen, and the alfalfa would help in the crop rotation and also serve as animal feed.

We know it will be a temptation to let the animals harvest the crop in the fields. There is no objection to this system, but the farmers must permit the crop to reach a height of at least 50 cm. before they turn livestock in the first time. Just as soon as the crop has been eaten off, livestock must remain off the land until the alfalfa again reaches a height of 40 cm. or 35 days have passed, whichever comes first. This process could be continued until the plant stops growing. Alfalfa will never become a weed because the flooding of the river each year will kill the plant. Sorghum should follow the alfalfa and be observed to see what effect the alfalfa had on the sorghum production.

Where alfalfa is seeded in rows, a high phosphate fertilizer of not less than 46 percent P_2O_5 should be tried on part of the crop at the rate of 15 kilos per hectare. Since the soil is reportedly acid, it might be advisable to treat part of the seed with molybdenum at the rate of 1 gram per kilo of seed. We would suggest the use of one of the soluble salts of the metal. The owners of the livestock should be cautioned about the possibility of bloat if the animals are permitted to eat much at any one time. We believe the effect will offer an opportunity to reduce the area in cultivation and with the possibility of increasing grain production and livestock feed at the same time.

The measure of success would be the effect of alfalfa on sorghum yield and the estimated livestock feed produced. We believe other demonstrations are not needed at this time unless the Mauritanian Government officials see a great need for this type of work.

BUDGET FOR FIELD TRIALS

Estimated costs for 40 field trials in the grain deficient areas of Mauritania for 18 months 1/ plus 10 alfalfa trials on overflow land at Kaedi or Boghe are as follows:

	First 6 Months	Last 12 Months
Travel, Dakar-Nouakchott/return 2/	1,500	1,500
Training personnel 3/	2,500	1,500
Equipment 4/	400	100
Secr. bi-lingual, 1/3 time 5/	1,500	1,000
Office space (1/3) 5/	1,200	2,400
House for technician and family 6/	1,500	3,000
Supplies for demonstrations	500	100
Rented ground travel in country 7/	2,500	1,500
Plane travel in Mauritania 8/	1,500	2,500
Publicity 9/	1,000	3,000
Records	300	700
Technician, USAID, 1/3 time 10/	5,000	10,000
	19,400	27,200
Overhead: 50 percent	9,700	13,600
	29,100	40,800

Total estimated cost, first 18 months: $69,900.

1/ Assumes that the technician would be stationed in Dakar and would devote about a third of his time to organizing and conducting field trials, including training and supervising personnel and arranging for publishing results.

2/ At least six trips would be necessary the first 6 months for the technician to become acquainted with officials, organize and consumate agreements for conducting field trials, train agents and become acquainted with local personnel, farming methods, and local conditions.

3/ Training of staff would be a continuing process, but would require more attention the first 6 months. Follow-through and review is a must.

4/ After establishment, this item is minor.

5/ Approximately a third of the estimated cost of two small offices for the technician and a secretary.

6/ A third of the allowance given the technician and his family.

7/ It appears advisable to rent ground transportation rather than purchasing vehicles.

8/ Assuming the results will justify broad publicity, a special effort should be made for government officials to see results. The only way to make this possible would be to fly them in chartered planes to the remote grain deficit areas. They could afford to be away from their offices only for very short periods of time.

9/ This is one item that is a must if the results are promising and show positive effects.

10/ It is assumed that the technician is highly qualified and would meet the special requirements for this position. He should have had extension experience and, preferably, would have a good knowledge of conducting field trials, would understand the importance of publicity, and would have the know-how to work with people in foreign lands. Above all, he must be fluent in conversational French, no less than a FSI-3 level.

APPENDIX C--SANITATION

Plate 4

Regional

Sanitation Program

A. General Storage Considerations

1. INSPECTION. An inspection program should be initiated to maintain a continuous check on the condition of grain being held in storage and on the condition of storage facilities and areas, regardless of the type of storage facility.

a. Storage Sites. Areas around the outside of storage facilities should be inspected routinely to detect:

(1) Accumulations of spilled grain which attract rodents and provide a breeding site for insects.

(2) Tall weeds, grass and accumulations of junk or other debris which provide cover for rodents.

(3) Evidence of rodent activity - burrows, runs, etc.

b. Storage Structures. Warehouses, unmechanized bins or silos, and mechanized silos should be routinely inspected for:

(1) Openings at or near ground level that would allow rodents to enter.

(2) Openings in upper areas that would allow birds to enter.

(3) Holes in roofs or other openings that would allow the grain to become wet by rain.

c. Condition of the Stored Grain. All grain when it is placed in storage should be inspected for moisture content, and the presence of insects, rodents and molds. It is particularly important that grain being carried over from one crop year to another be closely checked for the presence of insects, rodents and mold development.

To reduce the risk of serious losses due to insects and molds, the following general plan of actions should be followed:

(1) Know the moisture content of the grain. Do not attempt to store grain containing more than 13% moisture. Dry it to 12 to 12.5% moisture before placing the grain in storage. High moisture grain will spoil rapidly under West African conditions. Moisture migrates in stored grain under certain conditions. Initial low moisture, while good insurance, does not preclude localized high moisture due to migration.

(2) If it is possible to check the temperature of the grain in storage this should be done at least monthly, preferably more frequently. If localized temperature increases are noted in a quantity of grain, the cause should be determined. Sharp localized temperature increases will occur under two conditions. First, if large numbers of insects are present, their activity will result in a localized temperature increase. The temperature will not exceed 105-110° F. This condition can be corrected by fumigation.

Secondly, the temperature increase may be the result of mold growth in pockets of damp (high moisture) grain. This can occur due to moisture migration. Temperatures as high as 130° F. or higher can be experienced. Preferably this grain should be uniformly dried to 12.0% moisture content for safe long term storage.

(3) To detect the presence of insects in grain, a representative sample of the grain should be obtained. Grain samples should be sifted using a screen with openings approximately 0.083 inches in diameter (screen with 10 wires per inch). Any number of live weevils, borers (rice weevil, granary weevil, lesser grain borer) or Angoumois grain moths in the sample are indicative of "hidden infestation" (insects developing within the kernels of grain) and the grain should be fumigated. Grain that contains more than two other grain insects per kilo should be fumigated also.

(4) The presence of mold in grain is sometimes not easily detected by simple means. Obvious visual evidence of mold is an indication that moistures exceed that for safe storage and the grain should be dried or disposed of as soon as possible. Other indications of mold damage are discolored germs and/or reduced germination and there are some reasonably simple techniques for making these determinations.

2. HOUSEKEEPING. Probably the most important means of maintaining grain free of insect infestation and preventing losses due to rodents is through proper housekeeping of storage sites and structures.

a. Maintenance of the storage site.

(1) Spillage of grain in the area of the storage site should be prevented and if it occurs, should be cleaned up immediately. Not only does spillage serve as an attractant to rodents, it also attracts grain insects and provides a breeding site for them.

(2) Accumulation of chaff, hulls, and other materials cleaned from grain at the storage site should also be prevented. This material often contains enough grains to serve as a breeding site for insects.

(3) Tall weeds, grass and accumulations of equipment and debris provide cover for rodent activity. Weeds should be eliminated from the storage site by frequent cutting or the use of herbicides. Grass maintained around the storage structures, should be cut frequently.

b. Maintenance of the storage structure.

(1) A regular schedule should be established for cleaning areas of the storage structure - warehouse, silo, etc.

(2) Spillage and accumulation of grain and grain cleanings in warehouses and in other storage structures should be prevented, because they will attract and provide food for insects, rodents and birds.

(3) Housekeeping instructions for specific types of structures are given later in this section.

3. FUMIGATION

a. General Considerations

(1) Grain should be fumigated on the basis of need as determined by inspection of the grain.

(2) In areas where infestation of grain occurs in the field, fumigation within two weeks after initially storing the grain is recommended.

(3) It should be pointed out that an effective fumigation is dependent on confining a toxic concentration of gas within the grain mass for a sufficient period of time to kill all insects present in the grain. Too low a dosage, a container (bin or gas tight tarpaulin) which will not contain the gas or too short an exposure period are some factors that can result in an ineffective fumigation. Once the gas has been dissipated or escaped from the grain, the grain is again subject to infestation from outside sources.

(4) Routine fumigation of grain as an insurance measure is a reasonable practice but should not be relied on at the expense of an inspection program.

b. Materials and Dosages

(1) Phostoxin has proven an excellent grain fumigant and its use in the West African grain storage program is recommended.

This material:

(a) Has excellent penetrating and killing characteristics.

(b) Is easily applied to grain as it is moved in mechanized silo storage, can be used effectively in fumigating static stored bulk grain and sacked grain under gas tight tarpaulins or in gas tight enclosures.

(c) Is generally less hazardous to use than other fumigants, both from the standpoint of personnel safely and maintenance of grain quality. Unlike some other grain fumigants, Phostoxin does not adversely affect germination of seeds.

(2) The amount of fumigant required for an effective fumigation depends, as previously indicated, on several factors. Recommended Phostoxin dosage rates for various types of storage structures are indicated in the following table:

Type of Storage	Grain Temperature	Dosage/Metric Ton	Time
WAREHOUSE			
Bagged grain under gas-tight tarpaulin and bulk grain stored in piles or within bag bulkheads under gas-tight tarpaulins	54-59° F.	6 Tablets	4 Days
	60-68° F.	4 Tablets	4 Days
	69° F+.	3 Tablets	4 Days
NON-MECHANIZED SILOS			
Steel Bins	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Cement Block Bins	54-59° F.	7 Tablets	4 Days
	60-68° F.	6 Tablets	4 Days
	69° F+.	5 Tablets	4 Days
MECHANIZED SILOS			
Concrete elevators or steel tanks with turning facilities	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Concrete elevators or steel tanks with turning facilities	54-59° F.	25 Pellets	4 Days
	60-68° F.	15 Pellets	4 Days
	69° F+.	10 Pellets	4 Days

(3) The Manufacturer or his representative should be requested to supply literature and/or technical assistance regarding the application of Phostoxin. Properly controlled use of any fumigant is essential to attain satisfactory results.

Potential supplies of Phostoxin in West Africa include:

Chimie-Afrique
B.P. 1896
Abidjan, Ivory Coast

Chimie-Afrique
B.P. 1604
11, Avenue Jean Jaures
Dakar, Senegal

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 298
Accra, Ghana

Union Trading Co., Ltd.
Chemicals and Crop Protection Department
P.O.B. 8
Ibadan, Nigeria

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 572
Lagos, Nigeria

B. Specific Instructions for Various Types of Storage.

1. Warehouse Storage - Bagged Grain

a. Inspection of Grain

(1) Grain stored in sacks should be checked for the presence of insects, rodents and/or deterioration due to molds by visual examination of the exterior of the stack.

(2) Probe samples of grain should be taken at random from bags over the surface of the stack and examined for the presence of insects and/or mold. If live insects are found, the grain should be fumigated.

(a) Grain should be inspected at least monthly.

(b) Moisture content of the grain should be determined.

(c) Samples of grain from the interior of the stack cannot be taken practically, however, temperature cables (thermocouples) are available that can be placed within the stack as grain is stored. Temperature readings obtained in this manner can indicate heating within the stack due to insects and/or molds.

b. Storage Methods

(1) It is imperative that bagged grain be stacked off the floor on pallets in an orderly manner and that space be provided along walls, between stacks and above the stack so that gas-tight tarpaulins may be used to fumigate the grain if necessary. Stacks should not exceed 6 meters in width or height with length variable.

(2) Maintenance of the warehouse free of accumulations of spilled grain, cleanings from the grain and other debris is mandatory to prevent stored grains from becoming infested. Clean up should be accomplished daily.

(3) Reuse of sacks is an important source of cross infestation of stored grain. Bags should be fumigated before they are reused. This can be accomplished by placing the bags under a gas-tight tarpaulin similar to fumigation of stacks of bagged grain. Phostoxin at the rate of 45 Tablets per 1000 cubic feet of space can be used.

(4) Residual spraying of an insecticide can be used on floors and walls of warehouse especially along cracks and crevices to prevent build-up of insects in these areas and to prevent their migration to stored grain. Malathion is a suitable material for this purpose and should be applied according to the manufacturer's instructions.

c. Fumigation.

(1) Stacks of bagged grain should be fumigated using gas-tight tarpaulins. Polyethylene sheeting is a satisfactory material for this purpose. Heavier gauge (6 mil) polyethylene sheeting will allow the sheeting to be reused, however, lighter weight material will provide a satisfactory material for containing the gas.

To provide an effective fumigation, the gas-tight tarpaulin should be sealed to the warehouse floor so that the gas does not escape. Sand used to weight the edges of the tarpualin will provide a suitable seal if the floor is smooth.

(2) Phostoxin is an effective material for fumigation of bagged grain and should be applied in the dosages indicated earlier in this section.

2. Bulk-stored grain in unmechanized silos (including bulk stored grain in warehouses).

a. Inspection of grain

(1) Samples of grain from bulk stored grain should be obtained by use of grain "probes" or "triers". Samples can be taken from depths up to 18 feet (6 meters) with this type of equipment. Samples should be taken from various parts of the bin to obtain a representative sample.

(a) Grain should be examined for the presence of insects and/or mold. If insects are found, the grain should be fumigated.

(b) Moisture content of the grain should be determined. If moistures are above 13.5% or if molds are detected, the grain should be dried.

(c) Samples should be taken at monthly intervals.

(2) Temperature of the grain can be determined by various methods and can be used as a means of detecting heating caused by insects and/or molds.

(a) Portable temperature sensing cables (thermocouples) can be probed into the grain and temperature readings taken. Individual cables can be placed in the grain and left in place while the grain is in storage or one cable can be moved from one sampling point to another. Readings are taken by means of a portable battery operated potentiometer.

(b) Grain temperatures may also be determined by probing ordinary thermometers into the grain.

(c) Steel rods or wooden poles provide a crude means of determining whether grain is heating. To detect hot spots, the rods are pulled from the grain and felt with the hand. Warm areas on the rod indicate heating in the grain mass.

(d) If hot spots are detected, the cause should be determined by probe sampling and appropriate measures (fumigation or drying) taken to correct the situation.

b. Storage methods.

(1) Prior to placing grain in any silo (bin):

(a) The bin should be thoroughly cleaned to remove any old grain residues.

(b) The interior and exterior of the bin should be sprayed with an insecticide (malathion) about two weeks before grain is placed in the bin.

(2) The surface of the grain in the bin should be leveled in event fumigation is required.

c. Fumigation.

(1) Phostoxin tablets may be added to grain as it is placed in storage or they may be "probed" into the grain by means of a one-inch inside diameter pipe or conduit. Tablets should be probed into the grain mass to uniformly distribute them throughout the grain.

(2) If there is a relatively large space above the grain surface, a polythylene or other gas-tight sheet should be placed over the surface after the tablets have been applied.

(3) In situations where bulk grain is stored within bulk-heads formed of bagged grain, procedures recommended for stacks of bag stored grain are applicable.

(4) Dosage recommendations are given in the fumigation section, "A. General Storage Considerations".

3. Mechanized Silo Storage.

a. Inspection of Grain

(1) Samples from grain in mechanized silos usually have to be taken as the grain is moved from one silo to another.

(a) This can be done by having a worker obtain a series of small samples of grain from the conveyor discharge periodically as the grain is "turned".

(b) Samples should be examined for presence of insects and/or molds. If insects are found, the grain should be fumigated.

(c) Moisture content of the grain should be determined. If it exceeds 13.5% or has visible evidence of mold it should be dried.

(2) If temperature monitoring equipment is available in the silo bins, records should be made of the grain temperatures at least monthly, more frequent preferably. If localized temperature increases are noted in a bin of grain, the cause should be determined by turning the grain and sampling.

(a) If the quantity of grain heating is not large and the cause is damp grain, merely turning the grain may dissipate the heat and damp grain.

(b) If heating is caused by insects or if the quantity of damp grain is large, fumigation or drying will be necessary.

b. Storage Methods

(1) Mechanized silo bins should be cleaned and sprayed with insecticide (Malathion) as recommended for unmechanized silos.

(2) Accumulations of spilled grain, dust, grain cleanings, etc. should be cleaned up daily.

(3) Equipment used to handle grain - conveyors, elevators, etc. - should be cleaned out weekly and sprayed with an insecticide (Malathion).

(4) Service areas in mechanized silos (if they are present) such as tunnels beneath bins, enclosed areas above bins, etc. may be sprayed with an insecticide (Malathion) to prevent build-up of insects.

c. Fumigation.

(1) The only practical way of applying Phostoxin to grain in mechanized silos is to add the fumigant tablets (or pellets) to the grain stream as it flows into the silo bin. This can be done manually or automatic dispensing equipment can be used.

(2) Prescribed dosages are given in the Fumigation section of "General Storage Considerations".

C. Rodent Control.

1. The most effective way of reducing rodent populations is to eliminate harborage sites and other forms of cover and to limit their food supply.

a. Methods for limiting harborage sites and cover are outlined in the "General Storage Considerations" section.

b. Limiting the food supply is accomplished by keeping spillage of grain residues to a minimum in and around the storage facility and by providing a rodent proof facility.

2. Rodent-proofing of storage facilities, in part, can be accomplished by:

a. Placing ½ inch mesh screen over windows or other openings at or near ground level.

b. Sealing holes or small openings into storage facilities with metal.

c. Use of metal flashing around the base of storage facilities to prevent rodents from climbing rough surfaces.

d. Making doors to warehouses tight-fitting.

e. Any other means to prevent rodents from entering the storage facility.

3. Chemical control of rodents involves the use of toxic materials (rodenticides) to poison the rodents and should be accomplished by trained personnel.

a. Certain rodenticides will kill with one feeding and are hazardous to use near stored grain.

b. A group of materials called "anticoagulants" are used for rodent control in baiting programs.

(1) Anticoagulants are generally mixed with a cereal of some type (corn meal works well) and placed near storage facilities in bait stations.

(2) Rodents seek cover in the bait stations, feed repeatedly on the bait and die as a result of internal hemorrhage.

c. A regular program of baiting with anticoagulant rodenticides should be established at each storage site.

4. Various types of traps are available for rodent control. They should be employed in an integrated program of rodent proofing, housekeeping and baiting to maintain populations at a low level.

SUGGESTED PROJECT DESIGN

MAURITANIAN COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

INTRODUCTORY NOTE

The Mauritanian component of U.S. Agency for International Development (USAID) assistance to the OMVS 1/ Regional Grain Stabilization Project is authorized under Non-Capital Project Paper, Project No. 625-11-150-600, April 2, 1972, and revised March 1972. The long-run objective of this project is to involve the countries of Mali, Mauritania, and Senegal (members of the OMVS) in a regional program to manage cereal grain supplies. The project authorizes technical assistance and other funding inputs for an initial effort (FY 72-FY 75) to develop relevant and complementary domestic cereal grain supply management programs in each OMVS member country as a basis for initiating effective regional cooperation.

PROJECT SETTING AND RATIONALE

Mauritania has great need for a program which would help increase cereal grain production and develop a stable market for that production. Production has remained at 100,000 MT per year for the past 10 years, according to official figures, while population has been growing at a fairly low rate.

Rainfall is not over 600 mm. in the most favored sections of the country and is closer to 200 to 300 mm. in most of the agricultural areas. Often it does not rain at all and 3 of the past 4 years have been drought years. Although official production figures float along at 100,000 tons, good year and bad, drought probably cuts into production by 30 to 50 percent, and drops it to almost zero in many areas.

As a consequence there are seasonal and geographic shortages almost every year. That portion of the crop which is marketed, estimated at approximately 25,000 MT, is handled by small traders who buy at low prices on credit and resell at prices marked up from 3 to 4 times the purchase price. Drought season prices may reach 100 CFA/kilo or higher.

Mauritania, even in a normal year, must make up its food deficits through imports. These imports total close to 50,000 MT per year, about half of this is rice and the rest sorghum and millet. Most sorghum and millet has been imported from Mali but, during the past year or two, Mali has effectively cut off this trade, causing serious shortages in Eastern Mauritania.

1/ Organization for Development of the Senegal River Valley (OMVS) was created March 11, 1972, as a successor to the Organization of Sengal River States.

Given this set of conditions, a successful grain stabilization program is an urgent development need in Mauritania, both for its potential to solve internal production and distribution problems and for the hope of increasing regional grain trade through the OMVS mechanism.

Unfortunately, Mauritania is deficient in most of the elements necessary for a successful market stabilization effort, including:

- No existing government organization with cereal marketing responsibility.
- No cereal marketing policy.
- No trained cadre in marketing, storage, or sanitation.
- No storage facilities except at Kaedi and Selibaby.
- Extremely poor transportation system.
- Lack of a potential buying system (e.g., co-ops) in the countryside.
- An inadequately supported extension service.
- A minimal agriculture research system.
- An acute lack of resources to improve these deficiencies.

Mauritania does possess some important assets. Not the least of these is the acute awareness of officials at all levels of the need for action, both to increase food grain production and, concurrently, to provide a stable market. Moreover, as the result of earlier efforts at cereal marketing, most officials are knowledgeable of the elements of a grain stabilization program. They also have very strong opinions on why earlier programs failed.

Another asset is the potential for increased grain production, although within the limits of a capricious climate.

Although there is no government grain marketing organization in Mauritania such as OPAM in Mali, or ONCAD in Senegal, there is a government trading company, SONIMEX. This organization has a monopoly of trade in basic staples such as sugar and imported rice, and handles all donated grains. It, therefore, has an infrastructure of warehouses, stores, and personnel experienced in transport, selling, and warehousing, and offers an opportunity for nurturing the development of a grain stabilization program.

The Government of Mauritania (GOM) has succeeded in interesting various international organizations in its grain problem. The European Development Fund (FED) has indicated an interest in supporting the construction of grain storage. The World Food Program (PAM) has donated cereal grains to alleviate food shortages. The Government of Mauritania and international agencies working in an integrated program could successfully develop the needed infrastructure, market policy, and supply management mechanisms to arrive at a functioning grain stabilization program over the next 10 years.

The Mauritania Government policy on grain marketing is best indicated in its "Second Plan of Economic and Social Development, 1970-73:"

> "We do not have available at present sufficiently precise information to determine any objectives in millet production...
>
> "In awaiting the time when solid statistical information might be available, the state will take no measures tending to increase millet production, except the completion of small retention dams of which a certain number should be constructed in the next few years.
>
> "It is towards a policy of stabilization of markets, of a better distribution of the product, that we should direct ourselves from now on.
>
> "It is a question of launching, and in the least delay, an organization for the stabilization of markets. This organization should be given the means of storage which will permit it to store millet bought at a price profitable for the farmer and to resell it in times of scarcity at a price advantageous to the consumer. Even though it does not entirely supplant speculating middlemen, it will change their conduct to the extent that it will set the prices at which merchants will be obliged to follow in order to buy and sell.
>
> "This organization, which could be SONIMEX, should address itself to solving problems of transportation and to judiciously locate its storage warehouses."

The goals and objectives of the grain stabilization project can thus be seen to be in complete accord with and aimed to assist in the attainment of these stated objectives of the Government of Mauritania.

Most millet and sorghum in Mauritania is produced in the Senegal River Valley. Two cropping methods are followed; the first, relying on natural rainfall, calls for seeding in July and harvest in October. The second method is to plant along the river border as the flood waters recede from December to February. These methods are followed in the rest of the country, also, the latter in bas-fonds, particularly where retention dams have been built.

The most complete figures on production and consumption of sorghum and millet in Mauritania appeared in the 1968 SEDES Study, "Commercial Exchanges in Mauritania," and are presented by the WF Project of di Furia 1/as follows:

1/ On the Conditions and Possibilities to Create in the Islamic Republic of Mauritania a Regulative and a Reserve Stock of Sorgho. di Furia, Patteson, Pollaris, WFP, Dakar, May 16, 1970.

Table I.--Sorghum and millet production and consumption by region

Farmer Circles	Region	Production	Consumption	Surplus (+) or Short (-)
		metric tons		
Hodh Orient	1	17,016	19,216	- 2,200
Hodh Occid	2	8,410	10,860	- 2,450
Assoba)	3	10,885	13,435	- 2,550
Guidimaka)		23,053	11,053	+12,000
Gorgol	4	15,845	11,497	+ 4,350
Tagant)	5	3,083	3,483	- 400
Brakna)		19,977	18,527	+ 1,650
Inchire)	6	112	1,232	- 1,120
Trarza-Nkchtt)		5,978	12,978	- 7,000
Tiriaz-Advar) B. duLevrier)	7&8	1,062	3,442	- 2,380

The table above represents production in a normal year, and demonstrates that many areas are deficit even when rainfall is favorable. Serious drought, however, can reduce production by 30 to 50 percent.

To internal production must be added imports from Senegal and Mali, especially the latter. Most estimates place the level of net sorghum and millet imports at about 5,000 MT per year. The study team believes the level of imports is much higher, and feels the estimate by the Minister of Commerce of 25,000 MT per year is much closer to reality.

Assuming a normal production of 100,000 MT and imports of 25,000 MT, average consumption of millet and sorghum would be 100 kilos per capita under the best circumstances. Although this can be supplemented by various animal products, it is nevertheless only half the level of per capita consumption considered normal in Mali and Senegal.

We estimate that 30,000 to 35,000 MT of domestic production reaches commercial markets, plus the 25,000 MT of imports from Mali and Senegal. This is substantial trade, and it is hardly correct to say that a market does not exist in Mauritania. It is a highly speculative market, however, conducted almost entirely by petty traders. These traders habitually buy grain from farmers during the harvest period for 5 to 10 CFA per kilo. They then sell it throughout the rest of the year at prices ranging from 15 to 30 CFA. During drought years the farmer price may rise to 20 to 30 CFA per kilo. Resale price to consumers will inflate to 60 to 100 CFA per kilo.

Few, if any, dealers have storage facilities which enable them to store grain from one year to the next. Often the resale at inflated prices is to the same farmers who sold it at very low prices earlier the same harvest year. This shortage of grain is most acutely felt by producers June through September, the soudure period. Rather than pay cash, farmers will mortgage their next crop at the low prices indicated.

Much grain is resold in the area where it was purchased. However, as the table above indicates, much of it must be transported from surplus to deficit areas, and the high cost of transportation causes at least part of the price inflation already noted.

Transport rates are set by the state, and are 23 to 26 CFA per ton kilometer between Rossa and Kiffa, and 28 to 34 CFA per ton kilometer on the track between Kiffa and Nema. Thus, a sack of cement, fertilizer, or grain has more than doubled in cost between the port of entry at Rosso and Nema. Indeed the Government has found it necessary to subsidize part of the transport of certain foodstuffs and cement destined for the more distant regions. Many regions are in fact cut off one from the other during the rainy season, June through September.

These transportation difficulties have serious implications for a grain program. For one thing, a stabilization effort should attempt, as far as possible, to administratively link a surplus region with a nearby deficit area to minimize grain transfers. On the production side, high transport costs for fertilizer, which must be imported through Rosso, require a very high marginal return from fertilizer before its sale becomes feasible.

The team feels that there are substantial opportunities for increasing sorghum and millet production in Mauritania, particularly in the Senegal River Valley and in bas-fonds in other areas. Production increasing practices would include a wider use of animal traction, improved varieties, improved seeding and cultural practices, and, in some areas, the application of high analysis fertilizer, especially nitrogen.

Some research has been conducted on these problems at the IRAT station at Kaedi. Unfortunately, the researcher in charge of sorghum and millet research at Kaedi has been reassigned out of Mauritania, and in his absence the results of his experiments were unavailable. To the team's knowledge, little or no applied research or field trials have been conducted off the Kaedi station.

The Government of Mauritania has in the past launched campaigns to increase cereal production through increased use of animal traction, most recently in the First Region. An evaluation of the First Region program by GOM officials concluded that the campaign was very successful in increasing millet production, but that the program was a failure because a market stabilization program had not been developed concurrently. As a consequence, with substantial increased production, prices plummetted. Farmers could not repay their equipment loans, became discouraged, sold off their draft animals, and dropped out of the program.

The team suggests that any grain stabilization program in Mauritania include a production element which, during the first 3 years of the project, would emphasize:

- Assistance to an expanded program of millet and sorghum at the Kaedi research station, including extensive field testing in the various producing regions of the country.

- Strengthening the extension service cadre and program in the region chosen for launching a pilot market stabilization program.

- Development of a seed multiplication program of improved varieties.

GOM officials correctly believe that a production campaign cannot succeed unless a stabilized market is developed at the same time. The team suggests that the converse is equally true, especially where production, even under ideal conditions, continues to lag behind increasing food requirements.

Two recent and excellent studies have already addressed the problems of grain market stabilization and storage in Mauritania, including the one by di Furia previously cited and another by an Argentine expert, Cesar Lopez, on the possibility of constructing hermetically sealed subterranean silos for long-term storage. In general, these reports recommend:

- That storage for disaster relief and market stabilization be considered separately.

- That action on a market stabilization program be deferred due to the lack of infrastructure.

- That construction on five disaster-relief storage silos at Nouakchott, Kaedi, Makta-Lahjar, Kiffa, and Aioun be undertaken.

- That these silos have a total capacity of 5,500 MT. Lopez increased the recommendation on total capacity to 15,000 MT.

- That a subterranean, hermetically sealed storage design be used.

These studies are important not only for their detailed study of the situation, but because they form the basis of a FED program to assist Mauritania construct grain storage facilities.

The study team considers these structures an important part of any stabilization program. We basically agree with the earlier studies, but urge reconsideration of certain recommendations as follows:

- That, at this time, the structures be built and used for disaster relief storage in all regions but one. In this one region a market stabilization and production program should be launched on a pilot basis to test and develop market policy, train a cadre of managers and technicians, develop a cooperative system of buying points, and eventually establish a functioning grain stabilization organization under the tutelage of SONIMEX. Once this point has been reached, the program can be gradually extended to other regions.

- That the location of the storage facilities be reconsidered. The present team feels that Nema, Aroun, Kiffa, Kaedi (using existing facilities), Boghe, and Rosso conform better to areas of production

and consumption, transportation routes, and administrative centers than some of the sites recommended in the earlier reports.

- That the capacity of the storage to be constructed be increased to 1,500 MT each, and that existing storage at Kaedi and Selibaby be renovated, for a total initial capacity of 9,200 MT.

- That flat storage warehouses of the type recently constructed by SONIMEX in Nema and Aioun, reinforced and adapted to grain storage either in bulk or in sacks, be substituted for the recommended subterranean, hermetic silos.

The team makes the latter recommendation for several reasons. First, the hermetically sealed silos rely for their efficacy on the maintenance of the seal. They were recommended on the assumption that disaster-relief grain would remain sealed for periods of 2 to 3 years, until it was needed during a serious drought when shortages often reach to 30,000 or more tons. We feel, however, that, given a storage capacity of 5,500 to 9,200 tons and the dimensions of shortages even in normal years, grain would move in and out of these silos every year. It would be difficult, therefore, to maintain the seal. Furthermore, experience with this type of construction in Argentina has shown that, given normal wear and tear on the structures, the seal is difficult to maintain after the facility has been used a few years.

Secondly, equipment for discharging underground silos is more complicated and difficult to maintain than equipment for flat storage. A breakdown would present serious problems, whereas flat storage could be handled with manual labor.

Another reason for this recommendation is that costs of both types of construction are approximately equal (international at $60 per ton) and, in the event of a breakdown in the program, the flat type warehouse would be immediately adjustable to other uses. Underground silos would remain as unused monuments to a failed program.

Operationally, in a grain stabilization program, the action agency, probably SONIMEX,would stock all structures with donated grain and use these stocks for disaster relief while the market stabilization effort became operational. One region would be chosen as a pilot region for market stabilization. In this region the major storage facility would be stocked with millet purchased locally through farmer production and marketing cooperatives at prices announced by SONIMEX at the beginning of the cropping season. These prices would be compatible with world market and regional prices and with the specific economic situations of the Mauritanian market. SONIMEX would stay on the market throughout the year and price would be increased with time. Prices would in all cases cover costs of the marketing organization. Stored grain would be placed on the market by SONIMEX to relieve upward pressure on consumer prices and to relieve area shortages, or when called upon and to the extent available for disaster relief. In cases where prices are subsidized for purposes of disaster relief, SONIMEX will be reimbursed by the Government of Mauritania for its marketing costs.

This pilot marketing program will be evaluated and revised as experience deems it desirable, and will be extended to other regions over an established time schedule. In 10 years it is anticipated all warehouses will be stocked with grain purchased under such a market stabilization program rather than with donated grain. A production increasing program including both research field testing and extension and credit aspects will be launched concurrently in the pilot region.

REGIONAL AND PROJECT GOALS

SECTOR GOAL

The sector goal, measurements of goal achievement, and assumptions about goal achievement are documented in the appropriate section of the project PROP.

PROJECT GOALS - MAURITANIAN COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

The project goals for the Mauritanian component are:

1. To assist the Mauritanian Government develop a grain marketing policy and a long term supply-management and storage plan, both for disaster relief and market stabilization, including facility requirements and specifications.

2. To assist the Mauritanian Government develop an investment schedule of program inputs which will be required to support a viable program of supply management.

3. To assist GOM strengthen its research and extension programs in cereal grain production and coordinate them with the stabilization effort.

4. To assist GOM identify, collect, and evaluate the data required to develop an effective food grain program and ascertain the economic social and political results of alternative policies.

5. To assist GOM establish a grain marketing organization capable of effectively managing a stabilization program, including financial, accounting and inventory management, procurement, distribution, and transport practices.

6. To assist GOM develop the physical infrastructure necessary to a supply management program.

7. To assist GOM develop and complement effective training for all levels of management and technical personnel.

8. To achieve in Mauritania a program of food grain stabilization which will be compatible with the regional grain stabilization program of OMVS, and with the programs of member states.

9. Through the medium of OMVS to re-establish and regularize millet and sorghum commerce among member states.

OUTPUTS EXPECTED AT THE END OF PROJECT

Given the amount that needs to be done to establish an effective program in Mauritania, 3 years is not sufficient to obtain the overall sector goal stated in the project paper. A minimum of 10 years will be required to achieve an efficiently functioning food grain marketing program.

Substantial results indicative of progress can be achieved in the first 3 years of the project, however. GOM will have developed a long-term supply management policy and program of action. Also the Mauritanian Government will have developed an investment schedule of program inputs, including a priority sequence of investments for the supporting marketing infrastructure. An organizational structure, regulations, rules of procedure, and policy will have been developed for a grain stabilization organization.

Three of the five proposed storage structures will have been completed and action will be underway to complete the remaining two structures not later than the fourth year of the project. The existing storage facilities at Kaedi and Selibaby will also have been rehabilitated. At least two of the new or rehabilitated structures will be filled with donated grain and functioning as disaster reserve storage under the management of SONIMEX and local authorities.

A managerial and technical cadre will have been chosen and trained for central management and one regional price stabilization operation. The trained cadre will be in place and operational under the tutelage of SONIMEX in one selected region to conduct a market stabilization program beginning with the 1975 crop year.

An increased program of cereals research will have been undertaken at Kaedi, and at least 2 years of field trial results in higher yielding varieties, improved cultural practices, and fertilization will have been obtained and analyzed for the selected pilot region. A plan and schedule will have been developed and implementation would be underway for extending field testing to other regions.

A study will have been completed and implementation will have started on strengthening the extension program in the pilot region. Minimally this strengthening would include:

- Selection of well-trained agents capable of relating to the peasant population and motivated to work in the countryside.
- Retraining agents in skills required for the cereals programs.
- Increased materiel support.
- A demonstration plan, implementation starting no later than the 1974 crop year.
- A cooperative development plan, implementation starting no later than the second year of project.

Regional trade in cereal grain, particularly between Mali and Mauritania, will have been reestablished and regularized through the efforts of OMVS.

BASIC ASSUMPTIONS ABOUT OUTPUTS

Several basic assumptions are made regarding outputs. One is that the planning, implementation, and time phasing of the project will be allowed considerable flexibility subject to continuing review and revision as seen necessary by changed conditions, new or more completely developed information, accelerated inputs from other sources, development of more promising alternatives, improved technology, etc.

Another assumption is that the Government of Mauritania, through its officials, will continue to show an active interest in the project throughout its operation and will express this interest to all action agencies involved through timely policy, personnel, and budget support.

It is assumed that international assistance agencies already working in cereals development will continue their support, and that they will coordinate their efforts. In particular, FED will maintain its interest in furnishing storage facilities and PAM will continue to supply donated grain to the disaster relief program.

Also, all marketing policies developed and implemented within the context of the Mauritania project will be in harmony with the overall policies and goals of OMVS, and GOM will continue to support this regional harmony. The grain marketing organization developed in Mauritania will not seek monopoly control of the market, but will rely on and, in fact, assist in facilitating, under proper controls, the role of private dealers on the market.

STATEMENT OF PROJECT INPUTS

PERSONNEL

Advisory personnel required for the Mauritania component of the OMVS Regional Grain Stabilization Project and their major responsibilities are indicated below.

Regional Grain Marketing Advisor

USAID will provide, on a regional basis, one grain marketing advisor for OMVS. His primary area of expertise will be grain market policy and market development (including pricing, market analysis, policy formulation, and evaluation). This advisor will:

a. Serve as team leader of all advisors funded under this project and will coordinate all of their activities.

b. Be responsible for working with the governments of the cooperating countries in formulating market policies and procedures which are consistent and regionally compatible.

Man-months devoted to each country will depend on country program requirements. Base of operations will be Dakar. The advisor will be responsible for the following activities:

a. Advise the appropriate GOM agencies on matters of market policy formulation.

b. Assist the appropriate GOM agencies to formulate a comprehensive market development plan, including organizational structure, methods of financing, and operational procedures.

c. Assist appropriate GOM agencies develop present and anticipated program costs and utilize to the maximum extent the resources of the private sector toward an efficient stabilization program.

d. Assist appropriate GOM agencies determine the kinds of data required to formulate market policy, and develop a system for the collection and analysis of aggregate data.

e. Assist appropriate GOM agencies carry out market surveys, project commodity supply and demand schedules, and prepare long-term storage and handling facility plans.

f. Assist in the documentation and presentation of development loan justifications and backup data for the grain marketing program.

g. Coordinate Mauritania policy, planning, and implementation activities with those of other member countries and the regional association.

h. In collaboration with the Mauritanian grain marketing "zreualut" and those of the other OMVS countries and ITA, develop a regional grain standard.

i. In cooperation with all regional "zreualuts" and their organizations develop a system of regional crop reports and analysis.

Grain Marketing Specialist

USAID will provide one grain marketing specialist qualified and experienced in all managerial and technical aspects of grain marketing and storage. His primary responsibility will be to work with the Government of Mauritania and SONIMEX on program organization, management record systems, inventory control, quality control, development of long-term warehousing requirements, field organization, and managerial and technical training. Base of operations will be Nouakchott.

The grain marketing specialist in Mauritania will have the following responsibilities:

a. Serve as general marketing advisor to the management of SONIMEX.

b. Assist SONIMEX develop a grain commercialization section within its organizational structure.

c. Assist SONIMEX develop a set of operational plans and policies for this section.

d. Assist SONIMEX develop manpower requirements and a training plan for its grain commercialization personnel.

e. Assist SONIMEX develop a system of inventory management, records control, storage, handling, transport, and cost analysis procedures.

f. Assist SONIMEX develop storage facility designs as well as location and storage requirements projections, in collaboration with the regional grain marketing advisor and, as required, engineering consultants.

g. Assist SONIMEX plan, conduct, and evaluate market surveys and other data acquisition procedures.

h. Assist SONIMEX select a pilot grain stabilization region, develop and implement a grain stabilization plan in that region, analyze and evaluate the effectiveness of this pilot effort, and, using this experience, plan the expansion of the pilot program into other regions.

i. Assist SONIMEX plan and implement an effective insect, rodent, and pest control system in their grain storage.

j. Assist SONIMEX and the extension services plan and implement the formation of farmer production and marketing cooperatives in the pilot region and, on the basis of this experience, plan and implement expansion of the cooperative movement to other regions of the country.

k. Assist SONIMEX develop a set of grain standards and a system of crop reporting that conforms to an OMVS regional standard.

Technical Assistance to the Production Program

The guidelines available to the study team indicate that five project-supported personnel are the maximum, given the resources available. Considering program priorities we feel these should be a regional marketing advisor, three marketing specialists with the member country marketing organizations, and the agronomist already specifically committed to the Mali production program. We also feel, however, that the Mauritania program requires a production effort, and this effort will necessitate some technical assistance in both research and extension. We suggest that it might be made available from one or more of the following sources:

a. The project manager, who is a highly trained and experienced agronomist.

b. The agronomist presently in Dakar working on the major cereals project.

c. Short-term assistance from the project agronomist assigned to Mali.

d. Short-term consultants.

Consultant Services

USAID will provide, in addition to the project-funded technical advisors already described, short-term consultants as the program requires and as mutually agreed upon by the donor and donee. It is anticipated that additional consultant assistance may be required in the fields of engineering design, crop production, and transportation. For purposes of budget calculations, a total of 10 months consulting assistance per year (2 months per specialist assigned to the project) to meet all regional requirements have been provided.

TRAINING

Orientation

It is recommended that the Minister of Commerce or his representative and the SONIMEX staff member named to head the grain stabilization section make a minimum 10-day visit to Niger to study the management and operation of the Office of Productivity Vinners.

Executive Development

The following is considered the minimum level of participant training required under the project. Such training should be planned to commence as soon as the Government of Mauritania has assigned personnel to the designated positions and they can be taught English. All training would be very carefully specified by the regional marketing advisor and would be specifically tailored to the past experience and training of each candidate. Resident academic training would be conducted at the Food and Feed Grain Institute at Kansas State University.

a. Director or Deputy Director, Grain Stabilization Program. A 5-month resident program including 3 months grain marketing, 1 month cooperative credit, and 1 month warehousing and handling. The academic training would ideally be concluded with a 1-month field assignment to a large grain cooperative such as the Far-Mar-Co in Kansas City or the Arkansas Rice Producers Cooperative.

b. Chief, Grain Sanitation Program. The Mauritanian responsible for the sanitation program should receive a 3-month academic training program in all aspects of insect, rodent, fungus, mould, and other pest control at Kansas State. This should include substantial opportunity to observe sanitation programs in operation in the field.

c. Superintendent, Pilot Grain Storage Facility. This official should be provided with a minimum 3 months of resident training in warehousing management and techniques at Kansas State, plus a 1-month opportunity for on-the-job training at a comparable grain storage facility in the United States.

It is anticipated that all participants will be given English language training if needed. If this is not feasible, training will be arranged through ITA for comparable training either at ITA or in a French-speaking third country.

Middle Management and Technician-Level Training

It is difficult at this point to specify the amount of middle management and technician-level training which will have to be conducted, but given that most personnel involved with the program will require periodic retraining, it is a considerable amount. An excellent facility with some experience in the field already exists in Dakar (ITA). The Director of ITA has indicated a strong interest in active participation in the project. Attention must first be given to providing ITA with working copies of warehousing equipment to be used, some lab equipment, and course outlines. Concurrently the grain marketing specialist, in collaboration with the SONIMEX director of grain marketing, the regional advisor, and the ITA faculty, can develop and project specific training needs. Training will need to include units on procurement, receiving and handling, transport, record-keeping and accounting, grain handling, sanitation, fumigation, grain standards, care and condition of grain storage techniques, and operation and maintenance of handling equipment.

INFRASTRUCTURE

Storage facilities at three levels are critical to the success of a grain marketing program--major central facilities either in production or consumption areas, buying point facilities, and on-the-farm storage.

Major Central Storage

We recommend an intermediate goal (5 years) of five new facilities, 1,500 MT capacity each, and two rehabilitated facilities with a capacity of 1,700 MT, for a total storage capacity of 9,200 MT. This is short of the capacity needed for a fully effective disaster relief and price stabilization program, but large enough to be reasonably effective and to be within resource limitations. All warehouses should be constructed and put into operation as disaster relief storage within 5 years, except one where the disaster relief objective will be supplemented by a pilot price stabilization program.

The five new facilities will be of concrete construction 35 feet in width, 130 feet in length, and 23 feet in height at the eaves. Each will be divided into eight compartments with individual capacities of 187.5 MT when filled with bulk grain to a height of 15 feet. All walls must be grain-bearing to a height of 20 feet. Each bin must be gas-tight but need not be hermetically sealed. Additional construction details are contained in Appendix A. Cost data furnished by the Mauritanian Government indicates this type of storage facility can be built for approximately $60 per metric ton.

The team recommends that the grain storage facilities at Kaedi and Selibaby be rehabilitated. Recommended procedures for accomplishing this, including equipment to be used, are contained in Appendix A.

Buying Point Storage

The team suggests that viable cooperatives be developed to participate in both the production and commercialization aspects of the grain program. They could serve as agents for selling their members' grain either to SONIMEX or

other dealers at official prices. To function in this manner they must be equipped with three to five of these silos, each with a capacity of approximately 3 tons. The site and labor plus a minimum of 10 percent of the out-of-pocket costs for construction of these silos should be supplied by the co-op. Steel and cement would be furnished by the Government of Mauritania, either by grant or long-term loan to the co-op. As an adjunct to the program, several of these cooperatives could be furnished with a small threshing machine to test the demand for that service on custom basis.

We feel that at least 40 cooperatives would be necessary to support one major facility, and that these could be provided at a cost to the state of approximately $50 per metric ton.

The team suggests that the development of viable cooperatives capable of active participation in the production and marketing aspects of this project may be the most difficult part of the entire grain stabilization effort. We also feel it to be extremely important that the possibilities for cooperative formation and participation be tested in the pilot program.

On-the-Farm-Storage

With the notable exception of the Serikole, Mauritanians do not store grain on the head in farm granaries. This method of storage is, however, technically feasible and such storage facilities are probably the cheapest available, being built with farm labor and reasonably accessible inexpensive materials. The team suggests that an active component of the pilot region program be the encouragement of the construction and use of farm granaries. As an essential part of this program, the research organization should undertake a study of the economic and social factors which encourage sale or storage on the part of family decision-makers.

WORKING CAPITAL

Assuming that SONIMEX's costs for handling grain approach those of ONCAD in Senegal, and that the organization will handle approximately 1,500 MT when the pilot program is in full operation, the grain buying program itself will require a working capital of $180,000 in the pilot operation. This will increase to a little over $1 million as the program moves to other regions.

BASIC ASSUMPTIONS ABOUT PROJECT INPUTS

The following assumptions are made regarding project inputs:

- That AID can recruit personnel in a timely manner who have the required qualifications of education and experience and who speak French at a minimum level of FSI-3.

- That any AID personnel recruited to the program who do not speak French at a minimum level of FSI-3 will receive training to arrive at that level before they are assigned to post.

- That AID personnel assigned to the project not only be qualified technically and linguistically, but also be capable of functioning effectively in a different environment and, above all, be

able to establish effective working relationships and rapport with their Mauritanian counterparts and co-workers.

- That the Government of Mauritania and its action agencies will assign capable, active, interested personnel to all levels of the project; will make them available for training; and will assign them to the responsibilities for which they have been trained.

- That the action agencies of the Government of Mauritania will give wholehearted support to an effective program; that they will develop effective mechanisms, both official and informal, for close cooperation and collaboration; and that they will offer the opportunity for close working relationships and support to AID project personnel.

- That a small pool of capable, experienced management personnel exists within the SONIMEX cadre, and some of them will be assigned to the grain stabilization organization and programmed into executive development programs at an early date.

- That a substantial training capability for middle management and technical personnel already exists within the Institute of Food Technology at Dakar, and that it will be used to the maximum extent possible in training SONIMEX personnel.

- That, although the little work that has been done in the past in cooperative development in Mauritania has not been entirely successful, this failure has been due to planning and operational difficulties rather than the inability of the Mauritanian peasant to understand or to function within cooperative principles.

- That the Agricultural Services will be interested in both cooperative development and research and extension efforts to increase production in the pilot region; will lend their resources to this effort; and will cooperate closely with the grain marketing organization to plan and implement the project.

- That grant or loan financing on favorable terms will be available for infrastructure construction.

- That sufficient working capital can be made available for a grain buying program on the scale recommended.

BUDGET

PERSONNEL

AID will assign one grain marketing specialist to the program in Mauritania. Service of an AID grain marketing advisor will also be available to the Mauritania program, but budget for this person has been included under the Senegalese project design. We have assumed that the qualified grain marketing specialist who will work in Mauritania can be recruited and put on the job by June 1973.

Grain Marketing Specialist, Mauritania

	FY 1973	FY 1974	FY 1975
Salary	--	$28,000	$30,000
Language	$5,000	--	--
Travel to post	--	4,000	--
Education	--	3,000	3,000
Housing	--	8,000	8,000
Differential	--	7,000	7,500
Overhead	--	--	--
Per diem (100 days @ $25/day)	--	2,500	2,500
Equipment -			
Vehicle (hand power)	--	5,500	500
Professional equipment	--	500	200
On-the-job travel -			
Surface (10,000 mi. @ $.25)	--	2,500	2,500
Air	--	1,000	1,000
	$5,000	$62,000	$55,200

Assistance to the Production Program

It is not possible to develop a budget at this point, particularly since assistance to research and extension needed by the respective services to establish an effective pilot program in one region must be much more closely defined. Based on estimates developed for Mali, a tentative guideline might be:

FY 1973	FY 1974	FY 1975
$20,000	$30,000	$30,000

Consultation Services, Mauritania *

FY 1973	FY 1974	FY 1975
--	$10,000	$10,000

*Calculated on the basis of 2 months per staff member per year at the rate of $3,750 per month (salary plus per diem) plus travel.

TRAINING

Orientation

Trip of not more than 2 weeks for two officials to Niger, per diem plus travel, would cost $1,700 during FY 73.

Executive Development

Based on four participants, a total of 15 months training at Kansas State, with provision for educational travel and on-the-job training in the United States, would cost:

FY 1973	FY 1974	FY 1975
$4,000	$6,600	$3,500

This assumes training for one program director, FY 73; one warehouse supervisor and one sanitation supervisor in FY 74; and one warehouse supervisor in FY 75.

Middle Management and Technician Training

	FY 1973	FY 1974	FY 1975
Middle management Tng. at $180/trainee week, including room, board, and transportation.....	$3,600	$18,000	$18,000
Technician Tng. at $180/trainee week, including room, board, and transportation.....	3,600	18,000	18,000

INFRASTRUCTURE

Major Facilities

Included are 7,500 MT of new storage at approximately $60 per MT over a period of 5 years, plus rehabilitation and equipment of facilities at Kaedi and Selibaby at a total cost of $25,000.

	FY 1973	FY 1974	FY 1975	FY 1976-77
New facilities *.....	$50,000	$100,000	$100,000	$200,000
Rehabilitation & equipment.....	10,000	15,000	--	--

*To be provided through an FED loan or grant.

Buying Level Facilities

Equipping 40 cooperatives with 12 to 15 tons of storage capacity in Bambey, IRAT type silos at an estimated cost of $50 per metric ton. The team estimates that not over 30 of these cooperatives can be organized, equipped, and functioning within the first 3 years of the project.

FY 1973	FY 1974	FY 1975
$5,000	$15,000	$25,000

APPENDIX A - MARKETING

Since independence and possibly throughout its long history, Mauritania has been a deficient grain producing area. The GOM wishes to safeguard its people from the ravages of hunger and also prevent them from becoming victims of high prices demanded by speculators during periods of grain shortage. There is complete accord within the government on the need for a reserve of food grain strategically stored throughout the country plus a grain stabilization program to foster commercialization.

ACTION AGENCY

There exists no agency within the government responsible for regulation or actual marketing of grain. The private sector is fragmented into many small dealers who handle general merchandise; there are no dealers who handle only grain. There exists no credit structure to finance grain marketing, although many private speculators will extend credit in kind or food to the farming community.

There is, however, a quasi-private trading company, SONIMEX, that has a monopoly on imported sugar, rice, and other imported items. This company also handles all donation grain received from FED, AID, and other international relief agencies. The relief grain is not distributed to the people by SONIMEX but, rather, delivered to the government agency making the individual distribution or sold to local merchants. This company does have a good internal structure -- management, accounting, communication, traffic control, and storage facilities. They are successful in their handling of rice and sugar at the wholesale levels. Also they are exporters of gum arabic.

RESERVE STOCKS

One department of the government should be given total responsibility for supervising SONIMEX activities on the allocation, transportation, handling, and storage of all reserve stocks.

The storage facilities for the reserve stocks should be owned by the government and leased to SONIMEX for a term of years. The government should reimburse SONIMEX for all direct freight charges plus a markup of 3 to 5 percent. They should be paid a fair and reasonable handling, preservation, and storage charge based on quantity handled and length of time in store.

Handling (i.e., in and out) costs should be based on tonnage handled and any treatments for preservation or conditioning the grain,while storage should be on tonnage times the number of days or months the stock remained on storage. SONIMEX should not be required to make distribution to the public. They would only have to deliver from storage to some government relief agency or to retail merchants.

The company should not have the responsibility of determining when distribution of reserve stocks should be made. The company should be held financially responsible for quality and quantity delivered from the reserve stock.

The reserve stock should be weighed into each storage facility. SONIMEX should be allowed half of 1 percent weight loss each month for the first year, and a third of 1 percent per month for the second year. The third year the original stock is held in store the weight loss should be a sixth of 1 percent per month. Should the company be required to redeliver the entire reserve stock at the end of the third year, they would be required to deliver only 88 percent of the original weight received. If the weight loss is greater than this, the company would have to pay the government the difference at the market value of the commodity at the location where the loss occured.

COMMERCIALIZATION

The GOM should rehabilitate the concrete elevator at Kaedi and the steel tanks at Selibaby. SONIMEX should be appointed as an agent of the GOM to operate both elevators as a market and public warehouse. As agents of GOM the company would not be the owner of grain purchased nor would they be risking their own working capital or net worth.

The GOM, through its agent, SONIMEX, should offer a ready market at a reasonable price for all grain delivered to the storage facilities. They should also be willing to sell at the wholesale level at a reasonable price. Also, producers who sold their grain to these facilities should be preferred customers and allowed to buy back, at the wholesale price, up to half the amount they originally sold. A producer should also be allowed to store his grain in these facilities rather than selling it. He should be returned a like quality and quantity less a weight loss discount of half of 1 percent per month of storage. As a depositor he would be required to pay a fair and reasonable handling and storage charge. The storage charge would include fire insurance, care and preservation of the grain, as well as a charge for the space occupied.

WORKING CAPITAL

SONIMEX should be on a 30 day billing cycle to the GOM, so would not need any additional working capital. The company would not be financing any grain inventory in its name at any time, either under the reserve or commercialization program. The billing cycle could be shortened during periods when large quantities of grain are being purchased under the commercialization program.

INVESTMENT CAPITAL

To build and equip the reserve stock storage facilities would cost an average of U.S. $60 per MT. This would not include the necessary laboratory and grain preservation equipment. The country is so large and travel is so difficult it is suggested that three sets of equipment be secured.

The building should be constructed in such a manner that, at a later date, conventional grain handling equipment may be added without conversion of the facilities. This in itself will add to the original cost, but, as commercialization of grain becomes a reality, the reserve facilities can become a conventional grain market.

Building five new reserve stock facilities with a total capacity of 7,500 MT would call for a capital expenditure of U.S. $400,000. This should be financed through a grant from FED. The rehabilitation of two existing elevators plus the laboratory and grain preservation equipment would cost $25,000. This should be financed with an AID grant.

TRAINING

The coordinator of the two programs for the GOM should take a 5-month grain marketing course at Kansas State. This course should include 3 months on marketing, transportation, and accounting; 1 month on grain handling and preservation; and 1 month of on-the-job training with one of the larger grain cooperatives. During this last month the student should be exposed to farm practices; on-farm storage; country point storage; and warehouse stock control, handling, and preservation. From this formal education and exposure to the grain trade, he should develop an understanding of grades and standards. With this training he should be able to direct and evaluate SONIMEX performance in handling both grain programs.

SONIMEX, in cooperation with the GOM, should pick the seven men who will manage the storage facilities, as well as the headquarters man who will be the general manager of both grain programs. These men should take a complete grain marketing course at ITA. This course should cover handling, care, conditioning, and preservation of grain, as well as stock control, maintenance and repair of equipment, grades and standards, sanitation, and rodent control. The success of both programs will depend on how well these men understand the need for a stored grain inspection program and the various corrective measures that can be taken to safeguard stored grain. They must completely understand bird and rodent control as well as how to detect insect infestation, molds or fungi growth, and out-of-condition grain. They must develop a deep understanding of preventive maintenance, including not only the need for an inspection and reporting program, but also use of fumigants, grain preservatives, insect-tight buildings, and fogs and sprays.

The men who will manage the two existing elevators should likewise be given some training in the functions of marketing. This training may also be obtained in the new and expanded grain handling courses given at ITA.

Second level management and maintenance men should also be sent to ITA for specialized courses needed to develop necessary skills.

The GOM coordinator who has gone to Kansas State should spend 10 days to 2 weeks at ITA evaluating the training received by the SONIMEX employees.

FACILITIES

Reserve Grain Program

The five buildings for the reserve grain program should be of identical construction, each with a capacity of 1,500 MT. Each building should be concrete, 35' wide, 130' long, and 23' high at the eaves. Each should be divided into eight compartments or bins with an individual capacity of 187.5 MT when

filled with bulk grain to a height of 15 feet. All walls must be grain bearing to a height of 20'. Each bin or compartment must be gas tight but need not be hermetically sealed.

The roof should be poured concrete so no cold joint exists between the upright wall and the roof. The roof should also be constructed so wheelbarrows or bulk grain carts may be pushed from one end to the other. Three feet square hatches should be built into the roof to give access to each bin or compartment. These hatches should have gas tight seals, be located 6' from the center wall, and give access to a ladder constructed in the bin walls. These hatches could be used for inspections, fumigation, and filling the bins with bulk grain.

Each bin or compartment should communicate with an adjacent compartment through a doorway 4.75' by 7.5'. There should be a sliding door constructed of 3/4" plywood. The doors should open and close by sliding up or down on a track or guide. Each interior doorway should have two sliding doors, one for each compartment wall.

When the bin is filled with bulk grain, the weight of the grain on the door will make a gas tight seal. There should be at least 5 sq. feet of ventilation area in the outside wall of each bin; this opening would be screened and have a gas tight shutter that can be closed. There should be a gravity ventilation stack 24" in diameter serving each bin; this too should be screened and have a gas tight damper built in.

At one end of the building there should be a manually powered elevator equipped with a bulk grain hopper for delivery of grain to the hopper on the roof.

Existing Elevators

KAEDI ELEVATOR

The concrete elevator at Kaedi should be returned to service as storage for bulk grain through utilization of the simplest type of mechanization. The facility must be completely cleaned and all existing parts of the old pneumatic system removed. All of the pneumatic delivery pipes, flanges, and elbows should be saved, however, for possible use when more efficient mechanical handling equipment is needed in the future.

Two manually-powered freight elevators should be installed at the receiving end of the elevators. These freight elevators should be equipped with a bulk, self-cleaning hopper to receive the grain from a pit or hopper at ground floor level and transport it up to a receiving hopper at the bin top level. The bulk grain would be held in this upper hopper at the bin top level until it was allowed to flow by gravity to wheelbarrow or bulk grain carts for delivery to the individual bins. Each bin is now equipped with a discharge valve or gate that can be converted to a sacking off spout. The bulk grain can then be sacked as it is removed from the individual bins.

The manually powered freight elevator consists of a platform set between vertical guide rails that are matched with guides on the frame of the elevator

platform. The elevator platform is connected with two sets of counter-weights that run on the outside of the guide rails. The lift or power train of the elevator consists of one pulley 4' in diameter over which runs a 1-1/2 or 2 inch diameter rope drive. This rope runs from the pulley down the elevator shaft and returns to the drive pulley, forming a continuous rope drive. The pulley is connected to a steel shaft 2-1/2 or 3" in diameter, to which is attached the wire rope that is attached to the elevator platform. Pulling on the continuous rope drive by hand turns the pulley, which then turns the shaft, winding up the wire rope attached to the elevator platform, causing it to move upward. (See elevator example in Appendix D.)

The elevator shaft must extend through the ground floor level to a depth sufficient for the elevator hopper to be below the level of the loading hopper. The loading hopper should be at floor level so the full sacks need not be picked up but, rather, emptied at floor level into the hopper. The elevator shaft extends above the bin floor so the hopper on the elevator will empty by gravity into the hopper of the bin top level, from which the wheelbarrow or grain carts are filled by gravity.

After experience has been gained in elevator operation and men have been trained in handling conventional handling equipment at ITA, the elevator could be converted to standard handling equipment. After 5 years training and experience, two bucket legs, one overhead screw conveyor, and two screw conveyors for taking the grain from the tanks should be added. A cleaner, automatic scales, truck pit, and load out equipment should be added.

SELIBABY ELEVATOR

This is a small, four steel tank elevator with total capacity of 400 MT. The facility has not been used since 1955; hence, the handling equipment is in disrepair.

No action should be taken on this facility until the elevator at Kaedi has been in operation for one crop year. Then, the manager of the Kaedi facility and the manager-to-be of the Selibaby facility, who will both have attended the entire grain handling course at ITA under direction of American agricultural engineers based at Dakar, should be able to make the necessary repairs to put this plant into physical operation.

This operation may require the help of a TDY agricultural engineer for 6 weeks after the needed repair parts have been delivered to Selibaby.

Farm Storage

The producers should be encouraged to continue storing their grain on the cob or head in the traditional manner. The agricultural agents from Selibaby and Kaedi should be sent to ITA for a course in care and preservation of stored grain. From this training they could make marked improvements in the traditional village storage methods.

Co-op Level

At the co-op level, IRAT-type concrete tanks should be built. The construction of several of these tanks at the co-op level could be the uniting factor so necessary for a successful co-op. The village co-op member should see at once the added fire protection offered by these concrete tanks.

The co-op member should be required to furnish all labor and pay at least 10 percent of the capital expenditure required to build the tanks. The remaining 90 percent should be a loan from GOM.

GRAIN STANDARDS AND INSPECTION SERVICE

A simple grain standard should be developed in cooperation with ITA. This standard need not have the same grading standards as Senegal or Mali. However, its end objective should be to have a standard that is common through all of West Africa. While standards do not set grain prices, they establish understandable criteria on which value may be based. With acceptable standards also come market discounts and premiums. It is no longer necessary for the buyer to view every sack he buys once standards are accepted by the buyer and the seller.

SANITATION STANDARDS INSPECTION PROGRAM

In cooperation with ITA, sanitation standards should be drawn up for both the reserve grain and commercialization programs. Standards should be tight, as some of this grain may not be needed for a period of years.

Along with the standards, a reporting and inspection system should be established.

Each bin containing reserve stock grain should be inspected each month for infestation, conditions, etc. Samples should be drawn from five different locations within the bin and at various depths. Each probe sample should be identified and placed in a moisture proof grain can. The next day the sample would be run through a moisture meter and the moisture recorded on the inspection report. Temperature should also be taken at five different locations in each bin, at two depths. These temperatures would be recorded on the inspection report.

One copy of this inspection report goes to the GOM coordinator; one copy to the SONIMEX grain manager; and one to the manager of the facility where the inspection was performed. A single inspection report is usually of little value as it only reflects the condition of the commodity for an instance of time; however, when compared to several prior reports, it becomes a continuing history of the condition of the individual bin of grain. From this information it is often possible to project the continued storage life of the commodity. From these reports corrective action can be ordered and the next monthly report will give an evaluation of the corrective action taken.

This inspection program and the evaluation of the reports and the corrective action taken could and will be the determining factor as to whether the reserve grain program is a success or failure.

The sanitation program outlined in pages 209 through 219 of "A Study and Plan for Regional Grain Stabilization in West Africa" by Kansas State University, dated December 1970, is made a part of this report in its entirety. These pages are reproduced in Appendix C.

MARKET PRICES

Reserve Grain Stocks

With 7,500 MT of grain on long term storage, even under the best conditions, some of this grain will no doubt go out of condition. Should it appear to the facility manager or the general manager of the grain program for SONIMEX that an individual bin of grain is going out of condition, they should recommend to the GOM grain coordinator that the grain be sold.

This grain should be sold while it still has most of its food value remaining. The price should be just below the market price so the grain will move rapidly into the market place and be consumed.

The sign of a good warehouse manager is one who knows he has done all that is possible to safeguard the condition of the grain but, when it starts going out of condition, disposes of it while it still has food value. By so doing he will recover nearly 100 percent of the market value of the grain. Such conditions call for prompt action on the part of the grain manager of SONIMEX and the responsible official of the GOM.

The following is based on the conclusion that GOM has the authority to sell the reserve stocks when an emergency develops within the country's food chain.

With continuing review of crop reports, imported grain, and weather conditions, augmented by direct reports from responsible officials in the field, GOM should know several months prior to the existence of an actual food shortage. When the price has risen to 60 CFA per kg., the GOM should offer an undisclosed amount of grain at 50 CFA per kg. until the market reacts with lower prices to the consumer. GOM should then stop sales until the market price has again risen to 60 CFA per kg.

With this unannounced movement in and out of the market, GOM should be able to control prices and still force all of the speculators to sell their remaining stocks at or near a reasonable price.

A reserve stock of 7,500 MT is about 5 percent of the annual consumption. If GOM handed out the grain free whenever a serious shortage developed, the speculators would just hold their stock off the market for 2 weeks and the GOM supply would be exhausted. With the end of the GOM supply of reserve stock, the speculators would be free to enter the market at whatever price the traffic would bear. However, if the GOM enters the market with an undisclosed amount to sell at 10-15 percent below that market, the speculators would be forced to follow the market, hoping to sell as much as possible at even the reduced price. This would tend to utilize all resources of the country to move grain from other sources before GOM decided to further reduce that price. When the free

market reaches the government price, GOM should withdraw from the market until the free market again started up; they could then re-enter the market at a somewhat lower price again.

The prices used in the above are examples only. GOM might wish to enter before the price advanced to 60 CFA. The great danger is that GOM would want to utilize all reserve stock some weeks or months before harvest and, in so doing, would let the speculators set the free market price.

Commercialization

GOM should set and announce a basic price for grain before harvest. This basic price should be set after review of the market price at harvest during the past 5 years. This price need not be the 5 year average; however, the 5 year average should be used as a guide and tempered by current weather and harvest conditions.

The basic price should be just under the free market price. GOM would have the right and duty to increase this price if necessary, but not the right to reduce it below the announced basic price.

Every producer in the area should know that he can deliver his grain to the Kaedi elevator and receive at least the basic price in cash the same day delivery is made.

The base price should be advanced by a half CFA per month; i.e., if a base price of 20 CFA was being paid at harvest, the next month 20-1/2 CFA should be paid, then 21 CFA, etc. This would give the producer an incentive to retain all or part of his saleable crop in farm storage for later sales. However, should the free market advance at a much more rapid rate than the half CFA per month, GOM must follow the market until the price doubles that paid at harvest. Then, they should start selling at somewhat below the market. This action should have an immediate effect on the free market; for this reason, it is important that they acquire some inventory shortly after harvest, even if they have to pay somewhat over the free market. This will require fast and open communication between the warehouse manager, the grain manager of SONIMEX, and the grain coordinator of GOM to react to the market and to adjust the price being paid at the elevator to the market.

SHARE OF THE MARKET

Responsible GOM officials estimated production at about 100,000 tons and imports 25-50,000 MT. What percent of the production is marketed would not even be estimated by the same officials.

Possibly less than 10 percent of local production reaches the free market. The chief immediate benefit of a free market would be the breaking of the debt circle where the producers sell their grain to local dealers on credit before harvest for 10-15 CFA per kg. and receive food or grain at an inflated high price; i.e., some producers sell their grain before harvest at 10-15 CFA to actually buy grain at 50-60 CFA per kg.

The first year the Kaedi elevator is in operation may result in the purchase of only 3-400 MT. However, this would be a start and would show the producers they could receive the market price in cash and then have the opportunity to buy back at a reasonable price at a later date.

With the development of local co-op receiving stations, the elevator should be handling 2,000 MT within 5 years.

APPENDIX B: PRODUCTION

There are opportunities for increasing grain sorghum and millet production in Mauritania. Even at world prices of approximately 12 CFA FOB foreign port or nearly 15 CFA at a local port of entry, there are many improved production techniques and practices that appear feasible and could be highly profitable.

The greatest opportunities for increasing production in Mauritania are along the Senegal River where it overflows its banks every year. The river terraces are broad, nearly level alluvial plains of fine textured soil. There are indications the bank along the brink of the river is slightly higher than the main part of the wide terrace plain.

However, the river apparently flows at an extremely slow velocity. In June 1972, at low flow, the depth in some places near Bogue was estimated to be about 3 feet. The flow was reported to be 200 liters/second. This would be insufficient to irrigate even a small part of the land suitable for irrigation. Also, it was reported the Senegal River belonged to Senegal and, before much water can be applied to improve agriculture on the Mauritania side, it would be necessary to arrange some type of compact on water rights.

One difficulty of increasing production in the areas with greatest opportunities is that these areas are surplus producers and any additional production would tend to depress the grain price at harvest, making it lower than in the past unless an improved market system is established. The inelasticity of the market in Mauritania is almost beyond imagination. At times there is practically no market. There is no buyer with the necessary transportation or storage facilities to remove the surplus. The reported shift from a low price of 4 to 5 CFA/kilo to 80 CFA/kilo within the year must be corrected before a production program can be expected to succeed or should even be started, however.

In some of the deficit areas, namely Nema or Aioun, where the supply of grain seldom equals or exceeds the demand, the opportunities for increased production are more limited and hazardous. Here again, there are years when the harvest grain is far above the average and the price drops to a very low level; no buyer is large enough to be effective in stabilizing price. Many consumers in the area are nomads and storing large quantities of grain to meet their own needs for more than a short time cannot be expected. The movement of food is just an added burden and a 1 year supply is more than ample.

With this great fluctuation in production brought about by extreme differences in the weather and high cost of transportation to defict areas, it would not appear encouraging to suggest an extension production program at this time. At least there should be good evidence that recommended changes are almost sure to succeed. At present there are no results upon which recommendations can be formulated. This is especially true in the grain deficient areas. Unless it is possible to establish an assured, attractive price that will be paid for the grain at harvest, there is some question whether it would be wise to encourage the farmers to produce more than they need for their own use. Any addition would tend to make the merchant richer and the farmer poorer.

The price must be attractive enough to cause the cultivators of the land to either expand their operation to the more marginal areas or to apply more improved practices. Under present market structure and the high storage losses--reportedly, losses of farm-stored grain due to insects and rodents may be as much as 30 to 35 percent --there is little or no incentive to increase production.

QUESTION TO BE ANSWERED PRIOR TO INITIATING A CROP PRODUCTION PROGRAM

The team was not able to find any results of field trials or demonstrations in the grain deficient areas. According to the Insitut De Recherche Agronomique Tropicale (IRAT), no experiments or field trials have been made in the grain deficient areas in Mauritania. The same idea was expressed by the FAO representative working on Project 26, "Cooperative Regional Field Trials in West African Nations." Little can be demonstrated with reasonable assurance of success, then. It therefore seems logical to this team that the best approach would be to initiate some simple field trials of practices that appear most likely to result in profitable returns to the cultivator and increase grain production in most years.

One practice that appears to hold greatest promise is adjusting the planting rate to normal water supply. In grain deficient areas the normal yield is about 250 kilos/hectare. It has been the practice to plant 15 to 20 seeds in holes 150 cm. apart, thinning these to 3 to 5 plants per hole if and when they get around to it. These are more plants than recommended by IRAT even where the moisture supply is best. As a trial, the holes should be placed closer together, say 100 cm. or about 40 incres in each direction, to make better use of the water supply. All holes should be thinned to one plant per hole, or never more than two. This would be more in keeping with the recommended practice. This rate of planting would provide sufficient plants to far exceed the reported present yield of around 250 kilos per hectare.

There may be some questions about the low yield reported, as the average yield would be 364 kilos/hectare if we were to accept the calculated yields in the 1970 Report on the Conditions and Possibilities to Create in Republic Islamic of Mauritania a Regulative and a Reserve Stock of Sorgho, presented to the Government of Republic Islamic of Mauritania by the FAO/PAM mission consisting of R. di Furia, FAO, I. Pattison, FAO, and R. Pollaris, PAM. If we also accept the statements made by both farmers and government officials that the river terrace lands were producing between 400 and 500 kilos/hectare, then at least some of the less productive areas would be producing less than 300 kilos per hectare.

In all the trials we have been able to locate, there is every reason to believe early planting should be encouraged. Most results point to about a 2 percent decrease in yield for each day lost in planting. In every village, cultivators know it is important to plant as soon as possible after flooded land has dried sufficiently to work.

The present planting method is to dig a hole with a narrow bladed pick and then drop the seeds into the hole. In some places the farmer tries to scratch the surface lightly (3 to 5 cm. deep) to prevent crusting and reduce weed growth. There are a few three-tooth cultivators (tools) but not enough

for all farmers to use them. It takes animal power to pull the cultivator, which many of them do not have. Villagers reported one to two donkeys or a camel could provide the power, but many small farmers have neither. To expand this practice, animals would need to be rented or purchased and credit would need to be established to pay for this service.

There is one tool that was never mentioned that should be tried in a limited way; that is one of the simple hand jab corn planters that was in use about 50 years ago in the USA. If brought into the country, repair parts also need to be included. The soil may be too tight to use this type of planter successfully except on the sandy loams, but we believe this simple tool could hasten the planting operation.

Since there is every indication that it is very important to get this crop established as soon as possible and to make sure it is well established while there is a good moisture supply, the team recommends the use of a "starter fertilizer." We realize that fertilizer is expensive and it would mean the importation of an item not locally available; however, we are reasonably sure it is worth a try. From all observations and knowledge of similar experiences, we believe the fertilizer should be high in nitrogen and contain some phosphate. The team suggests that a 30-10-0 (Ammonium Phosphate Nitrate) or at least a 26-13-0 (Nitric Phosphate) be selected as the one to be tried the first time. It is not advisable to recommend or think of using a low grade fertilizer such as 14-7-7, which is recommended and in use in Senegal as well as a few places in Mauritania. The cost of transportation from port of entry (Rosso, Mauritania) to Nema is 30 CFA/kilo, the same as the cost of the fertilizer. This means 14-7-7 could not compete with a concentrated type even if it were free at the port of Rosso.

The present method of applying fertilizer is to broadcast it and then work it into the soil surface. We learned of only one tractor being used to work the fertilizer into the land, and that one was at Kaedi. With soils that have a high fixing power for phosphate and a lack of rainfall to carry the nitrates into the soil after the crops have been planted, it would be surprising to find a large increase from the use of fertilizer applied broadcast. This is <u>not</u> our recommended method of applying fertilizer to soil that is extremely low in both nitrogen and phosphate. Potassium is still a question, but we doubt that it is important in these soils as a "starter" fertilizer. The team therefore recommends that a high nitrogen-low phosphate fertilizer be tried at the rate of 10 kg./hectare applied in the hole with the seed at planting time. The rate of application may appear low, but this was used in the U.S. during the early days of fertilizing grain and found to produce increases in yields of corn from 200 to 300 kilos per hectare. Even at half this increase, this fertilizer would reduce grain import costs 10 to 15 percent.

From reports by farmers in the villages, we concluded most sorghum and millets are very tall (12 to 15 feet). This means much of the water required to produce the plants has been used to produce stalks rather than grain. Present varieties are mixtures of seed. We observed this as we examined the granaries and farm store houses. Orange or brown seeded sorghum is not liked by the people. They have the idea that, if they mix white and orange together, they can fool the birds; but, there is some question as to whether this is of

any importance. In one place we found a small plot near the river where the heads had been covered with rags to prevent the bird damage. If birds cannot be controlled by other means, bagging the heads might be worth a trial. But, if yields could be substantially increased by other improved practices, the children in the village could be more effective on chasing the birds out of the small area needed to be cultivated.

FIELD TRIALS RECOMMENDED

In light of these conditions, we would suggest small plot trials of the best white or yellow endosperm grain (not orange or brown), short, early, not day length affected, high-yielding variety recommended by IRAT, Bambey,Senegal.

We would recommend that four treatments be tried, with four replications at each trial. The plots should be laid out so each replication would be on or as near as possible to the same kind of soil and where the water stands about the same length of time. Each plot should be approximately 5 meters wide and about 40 meters long. The treatments are as follows:

(1) Farmers seed with the normal planting method.
(2) Farmers seed with method of planting + 1 gram (a 3-finger pinch) or granular 30-10-0 fertilizer dropped in the hole with the seed.
(3) Recommended seed planted in holes 1 x 1 meter and, after established, thinned to one plant per hole.
(4) Same as (3) but fertilizer added as in (2).

We suggest a 4 by 4 block design for the trials, with each treatment only once in each column. These trials should be established at the earliest possible date.

To avoid any possible adverse criticism of these trials, the farmer and land owner should be assured that, under no condition, will either suffer any loss due to the trials. Should there be loss, grain would be purchased and given to them to make up the difference. Any yield increases resulting from the trials would also go to the farmers and land owners for their cooperation. Since there will be 2 1/4 times as many holes to dig when the planting is 1 x 1 meter, the cultivator should also receive payment for his extra labor if the trials fail to increase yields sufficiently to properly reward the farmer and landlord.

A reduction in yield is unlikely, but any doubt about success should be eliminated from the beginning. No mention should be made of expected increases to either the farmer or land owner. These are trials only, and we are not trying to prove that they are using the wrong method or that we have a better one. It should be pointed out that we want to make these trials because we have hopes that one or more of the things we try will be something they will want to try again.

Each trial will require a very small amount of seed and fertilizer, not more than 1 kilo of each. In addition, the following items will be needed: a small spring scale, calibrated in kilos, for each cooperating agricultural agent so he can weigh the harvest; burlap bags, 100 kilo size, to hold the

harvested heads from each trial area; a small, inexpensive plastic rain gauge to measure rainfall at each village conducting the trials; and wet and dry bulb thermometers for each cooperating village.

Daily rainfall and temperature at sunrise, high noon, and sunset (taken on both wet and dry bulb thermometers) should be recorded. If it is possible to have a wind velocity gauge in an open area about 5 feet above ground level, wind velocity readings should also be recorded with the temperatures throughout the growing season. A simple pilot tube could be used to measure wind velocity. These data would be helpful in evaluating rate of transpiration and evaporation. Along with plant observations, they help determine rate of planting and whether additional plant populations would be beneficial. The number of heads (ears) produced and harvested on each plant should likewise be recorded, along with average weight per head. This would also give an idea as to best planting ratio.

Obtaining necessary equipment and supplies is relatively inexpensive and easy. The real problem is training people to do the work and then getting them to follow through to completion. Some type of incentive or reward should be provided for people who exceed the minimum requirements of job performance. Standards set for this reward should be such that 10 to 25 percent of the employees could reach them.

Production trials should start as soon as possible, as these should precede any widespread use of on-the-farm demonstrations. The main purpose of the field trials is to obtain information upon which to formulate demonstrations.

EVALUATING THE RESULTS

After the first year, the agronomist or technician assigned to this work should consult with research personnel in IRAT at Bambey and the yield trial officer of FAO to determine how the trials might be improved keeping in mind that the trials must remain simple and within resources of the farmer. This is no place for an in-depth research project. It must be kept practical, useful, and profitable to both farmer and landlord.

If near the end of growing season it can be easily seen that the trials will produce substantial yield improvements, an all out effort should be made to get important officials to see the results in the field before harvest. They should be photographed in the field and their comments should be broadcast and publicized. Officials should be assisted in every way possible to spread this information to other government officials who might be affected by or have influence on the actions taken by GOM. The use of the radio should be maximized. Promising results are of little value until they have been exploited by every means possible.

There is no question but what Mauritania could greatly increase production if it had modern equipment, trained people, irrigation, and all needed services at its disposal. But, this is impossible to think of at this time.

Mauritania expects to start research work on irrigated rice. We commend their efforts on this. Since the country imports 40,000 to 50,000 tons of rice annually, we would encourage them to proceed along this line. We know of no

better use of land suitable for irrigation under their present conditions. Even this change is going to require a great amount of training and far more cultivators (farmers) than presently employed in agriculture. Supervision of such an undertaking is almost beyond comprehension.

Since the change will probably take place slowly, though, we believe there are some other practices that should be tried in the surplus areas. For example, there is no question in our mind that the soil used for crops is extremely deficient in nitrogen, both total and available. The soil needs organic matter badly.

The livestock show every indication they are undernourished. The protein in their diet is at the subsistence level. The country would be far better off productively and financially with no more than half the present animal population. Far too much value has been placed on head count rather than returns from meat and milk. We understand it would take more than an act of government to reduce livestock numbers, so we believe a better feed source should be found which would improve both livestock and soil productivity.

Since most of the river terrace soils appear heavy textured, the legume-peanut does not seem advisable; therefore, we suggest a few trials of some African alfalfas, with seeding just as the water recedes from the land. Weeds may be the major problem if seeded broadcast. If this is the case, the alfalfa should be seeded in rows about 50 cm. apart and cultivated. Chickpeas might also be tried, but these may not have sufficient strength to penetrate the surface soil unless planted in holes and covered with sand. These legumes could furnish some of the needed nitrogen, and the alfalfa would help in the crop rotation and also serve as animal feed.

We know it will be a temptation to let the animals harvest the crop in the fields. There is no objection to this system, but the farmers must permit the crop to reach a height of at least 50 cm. before they turn livestock in the first time. Just as soon as the crop has been eaten off, livestock must remain off the land until the alfalfa again reaches a height of 40 cm. or 35 days have passed, whichever comes first. This process could be continued until the plant stops growing. Alfalfa will never become a weed because the flooding of the river each year will kill the plant. Sorghum should follow the alfalfa and be observed to see what effect the alfalfa had on the sorghum production.

Where alfalfa is seeded in rows, a high phosphate fertilizer of not less than 46 percent P_2O_5 should be tried on part of the crop at the rate of 15 kilos per hectare. Since the soil is reportedly acid, it might be advisable to treat part of the seed with molybdenum at the rate of 1 gram per kilo of seed. We would suggest the use of one of the soluble salts of the metal. The owners of the livestock should be cautioned about the possibility of bloat if the animals are permitted to eat much at any one time. We believe the effect will offer an opportunity to reduce the area in cultivation and with the possibility of increasing grain production and livestock feed at the same time.

The measure of success would be the effect of alfalfa on sorghum yield and the estimated livestock feed produced. We believe other demonstrations are not needed at this time unless the Mauritanian Government officials see a great need for this type of work.

BUDGET FOR FIELD TRIALS

Estimated costs for 40 field trials in the grain deficient areas of Mauritania for 18 months 1/ plus 10 alfalfa trials on overflow land at Kaedi or Boghe are as follows:

	First 6 Months	Last 12 Months
Travel, Dakar-Nouakchott/return 2/	1,500	1,500
Training personnel 3/	2,500	1,500
Equipment 4/	400	100
Secr. bi-lingual, 1/3 time 5/	1,500	1,000
Office space (1/3) 5/	1,200	2,400
House for technician and family 6/	1,500	3,000
Supplies for demonstrations	500	100
Rented ground travel in country 7/	2,500	1,500
Plane travel in Mauritania 8/	1,500	2,500
Publicity 9/	1,000	3,000
Records	300	700
Technician, USAID, 1/3 time 10/	5,000	10,000
	19,400	27,200
Overhead: 50 percent	9,700	13,600
	29,100	40,800

Total estimated cost, first 18 months: $69,900.

1/ Assumes that the technician would be stationed in Dakar and would devote about a third of his time to organizing and conducting field trials, including training and supervising personnel and arranging for publishing results.

2/ At least six trips would be necessary the first 6 months for the technician to become acquainted with officials, organize and consumate agreements for conducting field trials, train agents and become acquainted with local personnel, farming methods, and local conditions.

3/ Training of staff would be a continuing process, but would require more attention the first 6 months. Follow-through and review is a must.

4/ After establishment, this item is minor.

5/ Approximately a third of the estimated cost of two small offices for the technician and a secretary.

6/ A third of the allowance given the technician and his family.

7/ It appears advisable to rent ground transportation rather than purchasing vehicles.

8/ Assuming the results will justify broad publicity, a special effort should be made for government officials to see results. The only way to make this possible would be to fly them in chartered planes to the remote grain deficit areas. They could afford to be away from their offices only for very short periods of time.

9/ This is one item that is a must if the results are promising and show positive effects.

10/ It is assumed that the technician is highly qualified and would meet the special requirements for this position. He should have had extension experience and, preferably, would have a good knowledge of conducting field trials, would understand the importance of publicity, and would have the know-how to work with people in foreign lands. Above all, he must be fluent in conversational French, no less than a FSI-3 level.

Plate 4

Regional

Sanitation Program

A. General Storage Considerations

1. INSPECTION. An inspection program should be initiated to maintain a continuous check on the condition of grain being held in storage and on the condition of storage facilities and areas, regardless of the type of storage facility.

a. Storage Sites. Areas around the outside of storage facilities should be inspected routinely to detect:

(1) Accumulations of spilled grain which attract rodents and provide a breeding site for insects.

(2) Tall weeds, grass and accumulations of junk or other debris which provide cover for rodents.

(3) Evidence of rodent activity - burrows, runs, etc.

b. Storage Structures. Warehouses, unmechanized bins or silos, and mechanized silos should be routinely inspected for:

(1) Openings at or near ground level that would allow rodents to enter.

(2) Openings in upper areas that would allow birds to enter.

(3) Holes in roofs or other openings that would allow the grain to become wet by rain.

c. Condition of the Stored Grain. All grain when it is placed in storage should be inspected for moisture content, and the presence of insects, rodents and molds. It is particularly important that grain being carried over from one crop year to another be closely checked for the presence of insects, rodents and mold development.

To reduce the risk of serious losses due to insects and molds, the following general plan of actions should be followed:

(1) Know the moisture content of the grain. Do not attempt to store grain containing more than 13% moisture. Dry it to 12 to 12.5% moisture before placing the grain in storage. High moisture grain will spoil rapidly under West African conditions. Moisture migrates in stored grain under certain conditions. Initial low moisture, while good insurance, does not preclude localized high moisture due to migration.

(2) If it is possible to check the temperature of the grain in storage this should be done at least monthly, preferably more frequently. If localized temperature increases are noted in a quantity of grain, the cause should be determined. Sharp localized temperature increases will occur under two conditions. First, if large numbers of insects are present, their activity will result in a localized temperature increase. The temperature will not exceed 105-110° F. This condition can be corrected by fumigation.

Secondly, the temperature increase may be the result of mold growth in pockets of damp (high moisture) grain. This can occur due to moisture migration. Temperatures as high as 130° F. or higher can be experienced. Preferably this grain should be uniformly dried to 12.0% moisture content for safe long term storage.

(3) To detect the presence of insects in grain, a representative sample of the grain should be obtained. Grain samples should be sifted using a screen with openings approximately 0.083 inches in diameter (screen with 10 wires per inch). Any number of live weevils, borers (rice weevil, granary weevil, lesser grain borer) or Angoumois grain moths in the sample are indicative of "hidden infestation" (insects developing within the kernels of grain) and the grain should be fumigated. Grain that contains more than two other grain insects per kilo should be fumigated also.

(4) The presence of mold in grain is sometimes not easily detected by simple means. Obvious visual evidence of mold is an indication that moistures exceed that for safe storage and the grain should be dried or disposed of as soon as possible. Other indications of mold damage are discolored germs and/or reduced germination and there are some reasonably simple techniques for making these determinations.

2. HOUSEKEEPING. Probably the most important means of maintaining grain free of insect infestation and preventing losses due to rodents is through proper housekeeping of storage sites and structures.

a. Maintenance of the storage site.

(1) Spillage of grain in the area of the storage site should be prevented and if it occurs, should be cleaned up immediately. Not only does spillage serve as an attractant to rodents, it also attracts grain insects and provides a breeding site for them.

(2) Accumulation of chaff, hulls, and other materials cleaned from grain at the storage site should also be prevented. This material often contains enough grains to serve as a breeding site for insects.

(3) Tall weeds, grass and accumulations of equipment and debris provide cover for rodent activity. Weeds should be eliminated from the storage site by frequent cutting or the use of herbicides. Grass maintained around the storage structures, should be cut frequently.

b. Maintenance of the storage structure.

(1) A regular schedule should be established for cleaning areas of the storage structure - warehouse, silo, etc.

(2) Spillage and accumulation of grain and grain cleanings in warehouses and in other storage structures should be prevented, because they will attract and provide food for insects, rodents and birds.

(3) Housekeeping instructions for specific types of structures are given later in this section.

3. FUMIGATION

a. General Considerations

(1) Grain should be fumigated on the basis of need as determined by inspection of the grain.

(2) In areas where infestation of grain occurs in the field, fumigation within two weeks after initially storing the grain is recommended.

(3) It should be pointed out that an effective fumigation is dependent on confining a toxic concentration of gas within the grain mass for a sufficient period of time to kill all insects present in the grain. Too low a dosage, a container (bin or gas tight tarpaulin) which will not contain the gas or too short an exposure period are some factors that can result in an ineffective fumigation. Once the gas has been dissipated or escaped from the grain, the grain is again subject to infestation from outside sources.

(4) Routine fumigation of grain as an insurance measure is a reasonable practice but should not be relied on at the expense of an inspection program.

b. Materials and Dosages

(1) Phostoxin has proven an excellent grain fumigant and its use in the West African grain storage program is recommended.

This material:

(a) Has excellent penetrating and killing characteristics.

(b) Is easily applied to grain as it is moved in mechanized silo storage, can be used effectively in fumigating static stored bulk grain and sacked grain under gas tight tarpaulins or in gas tight enclosures.

(c) Is generally less hazardous to use than other fumigants, both from the standpoint of personnel safely and maintenance of grain quality. Unlike some other grain fumigants, Phostoxin does not adversely affect germination of seeds.

(2) The amount of fumigant required for an effective fumigation depends, as previously indicated, on several factors. Recommended Phostoxin dosage rates for various types of storage structures are indicated in the following table:

Type of Storage	Grain Temperature	Dosage/Metric Ton	Time
WAREHOUSE			
Bagged grain under gas-tight tarpaulin and bulk grain stored in piles or within bag bulkheads under gas-tight tarpaulins	54-59° F.	6 Tablets	4 Days
	60-68° F.	4 Tablets	4 Days
	69° F+.	3 Tablets	4 Days
NON-MECHANIZED SILOS			
Steel Bins	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Cement Block Bins	54-59° F.	7 Tablets	4 Days
	60-68° F.	6 Tablets	4 Days
	69° F+.	5 Tablets	4 Days
MECHANIZED SILOS			
Concrete elevators or steel tanks with turning facilities	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Concrete elevators or steel tanks with turning facilities	54-59° F.	25 Pellets	4 Days
	60-68° F.	15 Pellets	4 Days
	69° F+.	10 Pellets	4 Days

(3) The Manufacturer or his representative should be requested to supply literature and/or technical assistance regarding the application of Phostoxin. Properly controlled use of any fumigant is essential to attain satisfactory results.

Potential supplies of Phostoxin in West Africa include:

Chimie-Afrique
B.P. 1896
Abidjan, Ivory Coast

Chimie-Afrique
B.P. 1604
11, Avenue Jean Jaures
Dakar, Senegal

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 298
Accra, Ghana

Union Trading Co., Ltd.
Chemicals and Crop Protection Department
P.O.B. 8
Ibadan, Nigeria

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 572
Lagos, Nigeria

B. Specific Instructions for Various Types of Storage.

1. Warehouse Storage - Bagged Grain

a. Inspection of Grain

(1) Grain stored in sacks should be checked for the presence of insects, rodents and/or deterioration due to molds by visual examination of the exterior of the stack.

(2) Probe samples of grain should be taken at random from bags over the surface of the stack and examined for the presence of insects and/or mold. If live insects are found, the grain should be fumigated.

(a) Grain should be inspected at least monthly.

(b) Moisture content of the grain should be determined.

(c) Samples of grain from the interior of the stack cannot be taken practically, however, temperature cables (thermocouples) are available that can be placed within the stack as grain is stored. Temperature readings obtained in this manner can indicate heating within the stack due to insects and/or molds.

b. Storage Methods

(1) It is imperative that bagged grain be stacked off the floor on pallets in an orderly manner and that space be provided along walls, between stacks and above the stack so that gas-tight tarpaulins may be used to fumigate the grain if necessary. Stacks should not exceed 6 meters in width or height with length variable.

(2) Maintenance of the warehouse free of accumulations of spilled grain, cleanings from the grain and other debris is mandatory to prevent stored grains from becoming infested. Clean up should be accomplished daily.

(3) Reuse of sacks is an important source of cross infestation of stored grain. Bags should be fumigated before they are reused. This can be accomplished by placing the bags under a gas-tight tarpaulin similar to fumigation of stacks of bagged grain. Phostoxin at the rate of 45 Tablets per 1000 cubic feet of space can be used.

(4) Residual spraying of an insecticide can be used on floors and walls of warehouse especially along cracks and crevices to prevent build-up of insects in these areas and to prevent their migration to stored grain. Malathion is a suitable material for this purpose and should be applied according to the manufacturer's instructions.

c. Fumigation.

(1) Stacks of bagged grain should be fumigated using gas-tight tarpaulins. Polyethylene sheeting is a satisfactory material for this purpose. Heavier gauge (6 mil) polyethylene sheeting will allow the sheeting to be reused, however, lighter weight material will provide a satisfactory material for containing the gas.

To provide an effective fumigation, the gas-tight tarpaulin should be sealed to the warehouse floor so that the gas does not escape. Sand used to weight the edges of the tarpualin will provide a suitable seal if the floor is smooth.

(2) Phostoxin is an effective material for fumigation of bagged grain and should be applied in the dosages indicated earlier in this section.

2. Bulk-stored grain in unmechanized silos (including bulk stored grain in warehouses).

a. Inspection of grain

(1) Samples of grain from bulk stored grain should be obtained by use of grain "probes" or "triers". Samples can be taken from depths up to 18 feet (6 meters) with this type of equipment. Samples should be taken from various parts of the bin to obtain a representative sample.

(a) Grain should be examined for the presence of insects and/or mold. If insects are found, the grain should be fumigated.

(b) Moisture content of the grain should be determined. If moistures are above 13.5% or if molds are detected, the grain should be dried.

(c) Samples should be taken at monthly intervals.

(2) Temperature of the grain can be determined by various methods and can be used as a means of detecting heating caused by insects and/or molds.

(a) Portable temperature sensing cables (thermocouples) can be probed into the grain and temperature readings taken. Individual cables can be placed in the grain and left in place while the grain is in storage or one cable can be moved from one sampling point to another. Readings are taken by means of a portable battery operated potentiometer.

(b) Grain temperatures may also be determined by probing ordinary thermometers into the grain.

(c) Steel rods or wooden poles provide a crude means of determining whether grain is heating. To detect hot spots, the rods are pulled from the grain and felt with the hand. Warm areas on the rod indicate heating in the grain mass.

(d) If hot spots are detected, the cause should be determined by probe sampling and appropriate measures (fumigation or drying) taken to correct the situation.

b. Storage methods.

(1) Prior to placing grain in any silo (bin):

(a) The bin should be thoroughly cleaned to remove any old grain residues.

(b) The interior and exterior of the bin should be sprayed with an insecticide (malathion) about two weeks before grain is placed in the bin.

(2) The surface of the grain in the bin should be leveled in event fumigation is required.

c. Fumigation.

(1) Phostoxin tablets may be added to grain as it is placed in storage or they may be "probed" into the grain by means of a one-inch inside diameter pipe or conduit. Tablets should be probed into the grain mass to uniformly distribute them throughout the grain.

(2) If there is a relatively large space above the grain surface, a polythylene or other gas-tight sheet should be placed over the surface after the tablets have been applied.

(3) In situations where bulk grain is stored within bulk-heads formed of bagged grain, procedures recommended for stacks of bag stored grain are applicable.

(4) Dosage recommendations are given in the fumigation section, "A. General Storage Considerations".

3. Mechanized Silo Storage.

a. Inspection of Grain

(1) Samples from grain in mechanized silos usually have to be taken as the grain is moved from one silo to another.

(a) This can be done by having a worker obtain a series of small samples of grain from the conveyor discharge periodically as the grain is "turned".

(b) Samples should be examined for presence of insects and/or molds. If insects are found, the grain should be fumigated.

(c) Moisture content of the grain should be determined. If it exceeds 13.5% or has visible evidence of mold it should be dried.

(2) If temperature monitoring equipment is available in the silo bins, records should be made of the grain temperatures at least monthly, more frequent preferably. If localized temperature increases are noted in a bin of grain, the cause should be determined by turning the grain and sampling.

(a) If the quantity of grain heating is not large and the cause is damp grain, merely turning the grain may dissipate the heat and damp grain.

(b) If heating is caused by insects or if the quantity of damp grain is large, fumigation or drying will be necessary.

b. Storage Methods

(1) Mechanized silo bins should be cleaned and sprayed with insecticide (Malathion) as recommended for unmechanized silos.

(2) Accumulations of spilled grain, dust, grain cleanings, etc. should be cleaned up daily.

(3) Equipment used to handle grain - conveyors, elevators, etc. - should be cleaned out weekly and sprayed with an insecticide (Malathion).

(4) Service areas in mechanized silos (if they are present) such as tunnels beneath bins, enclosed areas above bins, etc. may be sprayed with an insecticide (Malathion) to prevent build-up of insects.

c. Fumigation.

(1) The only practical way of applying Phostoxin to grain in mechanized silos is to add the fumigant tablets (or pellets) to the grain stream as it flows into the silo bin. This can be done manually or automatic dispensing equipment can be used.

(2) Prescribed dosages are given in the Fumigation section of "General Storage Considerations".

C. Rodent Control.

1. The most effective way of reducing rodent populations is to eliminate harborage sites and other forms of cover and to limit their food supply.

a. Methods for limiting harborage sites and cover are outlined in the "General Storage Considerations" section.

b. Limiting the food supply is accomplished by keeping spillage of grain residues to a minimum in and around the storage facility and by providing a rodent proof facility.

2. Rodent-proofing of storage facilities, in part, can be accomplished by:

a. Placing ½ inch mesh screen over windows or other openings at or near ground level.

b. Sealing holes or small openings into storage facilities with metal.

c. Use of metal flashing around the base of storage facilities to prevent rodents from climbing rough surfaces.

d. Making doors to warehouses tight-fitting.

e. Any other means to prevent rodents from entering the storage facility.

3. Chemical control of rodents involves the use of toxic materials (rodenticides) to poison the rodents and should be accomplished by trained personnel.

a. Certain rodenticides will kill with one feeding and are hazardous to use near stored grain.

b. A group of materials called "anticoagulants" are used for rodent control in baiting programs.

(1) Anticoagulants are generally mixed with a cereal of some type (corn meal works well) and placed near storage facilities in bait stations.

(2) Rodents seek cover in the bait stations, feed repeatedly on the bait and die as a result of internal hemorrhage.

c. A regular program of baiting with anticoagulant rodenticides should be established at each storage site.

4. Various types of traps are available for rodent control. They should be employed in an integrated program of rodent proofing, housekeeping and baiting to maintain populations at a low level.

APPENDIX D--HAND POWER ELEVATOR

Restoration of the concrete elevator located at Kaedi as explained in Appendix A calls for the construction of two manually powered elevators. This Appendix includes illustrations of hand powered elevators with lifting capacity from 10 to 100 bushels. Specifications are given for each type and model illustrated. Enough detail is given that any engineer should be able to design the type needed to service the Kaedi elevator.

All illustrations show general freight elevators rather than bulk grain equipment; however, the size and shape of the platform or cars can be changed or modified to handle bulk grain.

The specifications for the winding machine, supports for the winding machine, counter weights, guide strips, and ropes could all be followed as outlined.

The illustration and detail specification was supplied by Mr. John Lusti, Vice President and Chief Engineer, Engineering Division of Otis Elevator Company. This is not a sales brochure by Otis but, rather, a public service to the Government of Mauritania and the United States. It took much research on the part of Mr. Lusti and his staff to furnish this information.

NO. 1 CENTER LIFT
HAND POWER ELEVATOR

THE NO. 1 Hand Power is especially adapted for light loads and small platform sizes. The rope or pull wheel may be placed at either the front or at the side, thus making it possible to install this type in either an open or enclosed hatchway.

We strongly recommend the sidepost arrangement shown in illustration. When conditions are such that the guide posts must be placed in the corners of hatchway, we can furnish special construction, for which drawings are necessary in each case to show size of hatchway required.

Special attention is called to the Steel Frame Platform and "Power" Type Safety Device furnished with all Otis Hand Power Elevators. These features differ slightly on the various types as conditions demand.

Specifications for the above are as follows:

Lifting Machine
- Rope or Pull Wheel
- Gearing and Shafts
- Hoisting Sheave
- Roller Bearings
- Steel Band Brake

Overhead Frame

Counterweights
- Adjustable

Platform—Steel Frame
- Safety Device

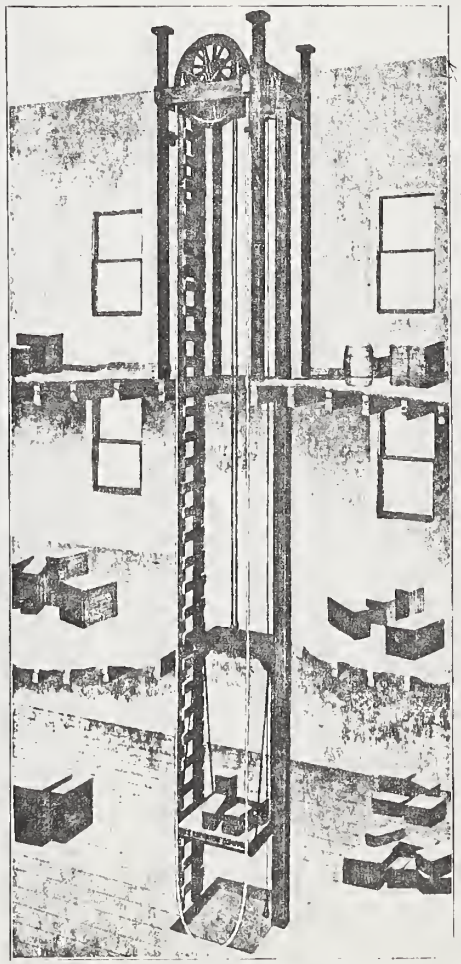
Guide Strips
- Maple

Ropes
- Two $\frac{1}{2}$" Iron Lifting Cables
- One $1\frac{1}{8}$" Manila Hand Rope
- One $\frac{1}{2}$" Brake Rope

We furnish complete drawings and instructions for erecting.

NO. 1 CENTER LIFT HAND POWER ELEVATOR

Capacities 500 and 1000 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back	Postwise		Front to Back
3′ 0″	x	3′ 0″	4′ 0″	x	4′ 0″	4′ 0″	x	5′ 0″

NO. 4-A
HAND POWER ELEVATOR

THE No. 4-A is the most popular type and well deserves the great popularity which it has attained, being within its range, the best and most economical Hand Power Elevator ever built for the handling of general merchandise. It is simplicity itself to erect (another economical feature) and its easy running qualities and durable construction have met with ever growing favor.

It is not adapted for an enclosed hatchway, corner guides, nor for pull wheel in front.

If you wish to know how little money will purchase a high class Hand Power Elevator, write for prices of the No. 4-A.

Specifications for the above are as follows:

Winding Machine
- Rope or Pull Wheel
- Shafts and Gearing
- Iron Drums
- Roller Bearings
- Brake

Supports for Winding Machine

Counterweights
- Adjustable

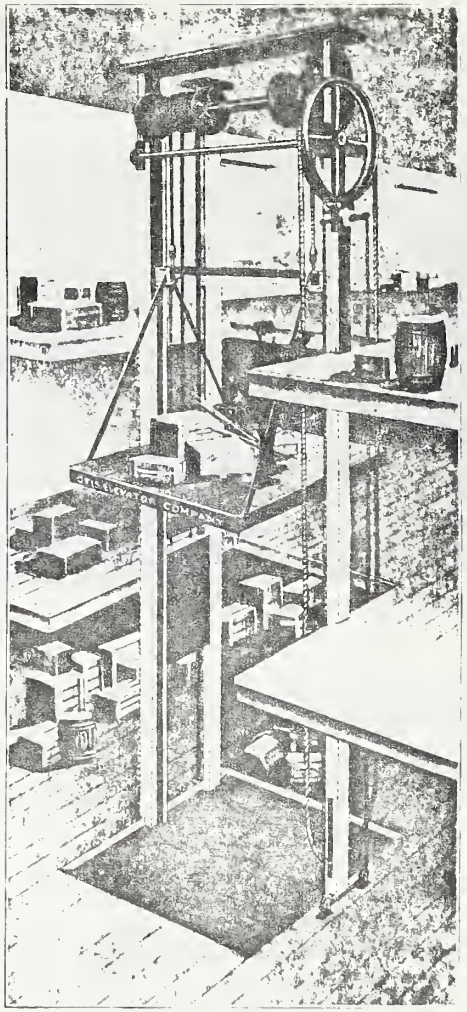
Platform—Steel Frame
- Safety Device

Guide Strips
- Maple

Ropes
- Two $\frac{1}{2}$" Iron Lifting Cables
- One $\frac{1}{2}$" Iron Weight Cable
- One $1\frac{1}{8}$" Manila Hand Rope
- One $\frac{1}{2}$" Brake Rope

We furnish complete drawings and instructions for erecting.

NO 4-A HAND POWER ELEVATOR
Capacities 1500, 2000, 2500 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back	Postwise		Front to Back
4′ 0″	x	4′ 0″	5′ 0″	x	5′ 0″	6′ 0″	x	7′ 0″
4′ 0″	x	5′ 0″	5′ 0″	x	6′ 0″	6′ 0″	x	8′ 0″
4′ 0″	x	6′ 0″	5′ 0″	x	7′ 0″	7′ 0″	x	7′ 0″
			6′ 0″	x	6′ 0″			

SOME DETAILS

IN order to prove the Otis claim of superiority and in line with the policy of furnishing "The maximum value for a dollar" we show herewith cuts of the various parts which clearly illustrate in detail, the design, workmanship and method of constructing Otis Standard Hand Power Elevators.

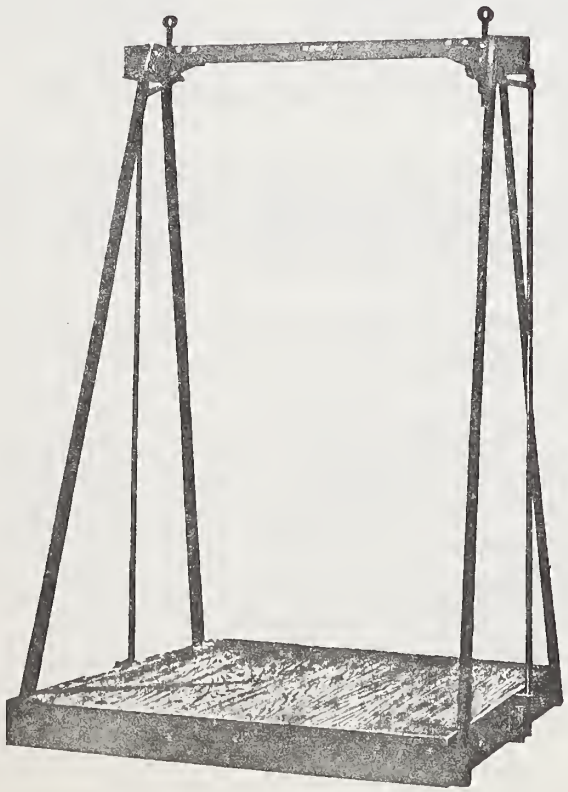


Figure 1. 4-A Platform

PLATFORM

ALIVE to the fact that platforms made of wood do not always give the best satisfaction, we have designed a *Steel Frame Car* (Figure 1) with no wood used in this construction except for the flooring.

Further, this car is equipped with a type of safety similar to that used on Electric and other "Power" Elevators, thus making a much more effective device than the old style of Beam Spring Safety.

Figure 2. Bottom View of Platform

In Figure 2 a bottom view of the platform is shown, giving a clear idea of the safety dogs, the method of bracing, and the strong construction.

GUIDE POST AND STRIPS

OWING to the fact that guide post stock can be obtained from any lumber yard, the customer often prefers to purchase his posts locally and save the freight charges.

A solid post of proper size can be used, but we strongly recommend the use of a compound post as shown in Figure 3, in order to eliminate warping and twisting. Although the cost of this post is greater than the old style solid one, we furnish compound posts in all cases, when posts are ordered, thus assuring the purchaser of absolutely true runways for his platform.

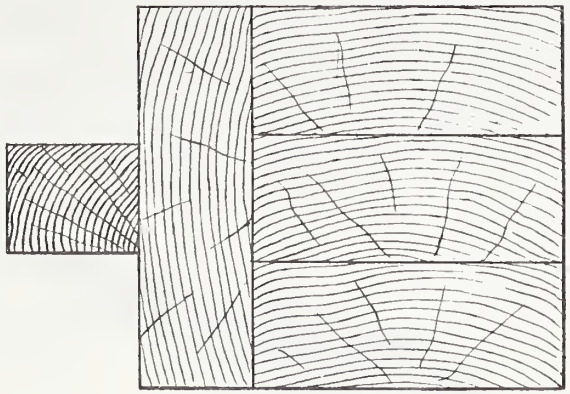


Figure 3. Compound Guide Post

The guide strips are made of well-seasoned kiln-dried maple, being tongued, grooved and drilled on a special machine built for this purpose. No difficulty can be experienced in accurately erecting.

GEAR AND DRUMS

PARTICULAR attention is directed to the gear and drums shown in Figure 4.

These drums are made of iron with machine scored grooves. This construction is a marked improvement over the wood or cast groove drums.

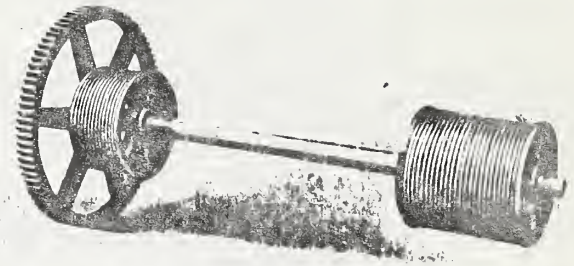


Figure 4. Gear and Drum

Another indication of Otis quality is shown in Figure 5.

This is the steel anti-friction roller bearing in which all shafts are mounted, thus making a smooth and easy running elevator instead of the usual "*Man Killer.*"

Figure 5. Roller Bearing

ROPE WHEEL

Figure 6. Rope Wheel

THE parts shown in Figure 6 are the Rope or "Pull" Wheel and Pinion. These are accurately made and mounted on a heavy steel shaft. The flange of the Rope Wheel, on which the brake operates, is accurately machined insuring a positive and easy stop.

BRAKE

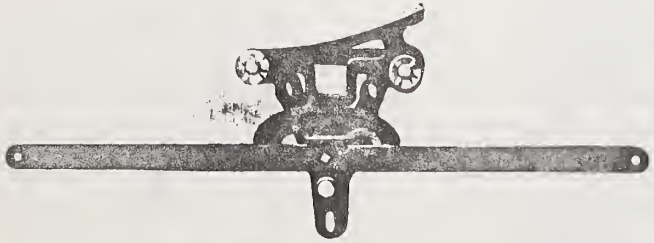


Figure 7. 4-A Brake

Realizing the importance of the brake, every care has been taken to provide *Otis Elevators* with the best possible braking appliance. The illustration (Figure 7) shows the cam or rocker style—(used with the 4-A elevator) a type which has proven most safe and efficient. The brake is made substantially throughout and the shoe is lined with leather to insure both gripping efficiency and quietness of operation.

INSTRUCTIONS

WE give below a fac-simile of our Standard Erecting Instructions, which we send out with every 4-A elevator. With these instructions also go erection drawings, showing the purchaser the best and most economical way in which to erect.

OTIS ELEVATOR COMPANY

DIRECTIONS FOR ERECTING
HAND POWER ELEVATOR
SIZE No 4-A

Before commencing work, be sure that the openings in the different floors are PLUMB, and that dimensions agree with those indicated on erection plan.

GUIDE POSTS

After locating center line of opening (front to back) place the main guide posts on counterweight side in position. As the erecting plan shows, the side of this post next to the counterweight should be 4 ¼ inches from the center line of opening, and should project into opening 4-½ inches.

The guide posts (usually furnished by purchaser) are 5-½" x 5-½" (except in upper story, which are 5-½" x 7" and are shipped with elevator). The face of these upper posts should be flush with those placed in lower stories.

Next, place weight post in position, taking proper measurement from erection plan after which the main guide post on opposite side of hatchway should be placed. Care should be taken to have the measurement between these posts exactly in accordance with the erection plan A gauge giving this exact measurement is sent with each elevator and will be found attached to one of the posts

GEARING

The gearing should now be placed and care taken to have shafts revolve freely in the roller bearings Attach all guide strips with exception of about eight feet in the lower story put platform together and place in proper position

ROPES

The cables should now be secured by means of the clamps inside of drums and to the eye bolts on platform. The lifting cables should be even in length and the same allowance made for take-up at eye bolts.

Place hand rope in place; the post in lower story should be slotted as shown in erecting plan, and before splicing this rope have it when hanging free reach about midway of the slot so that in case of shrinkage the rope will not bind against the post. Place brake rope in position, passing around the two small sheaves at lower landing. Raise platform to upper landing and attach guide strips at bottom.

COUNTERWEIGHTS

Place counterweights in guides, with a 12 inch block underneath; attach counterweight cable, lower platform, and remove block under weight.

Bring platform level by adjusting eye bolts to which lifting cables are attached.

SAFETY DEVICE

The trip rods at each side of platform should be evenly adjusted by means of adjusting nuts at top of each rod. The lower end of each rod is fitted with a special washer (No 1983), holding a coil spring (No 723) the rod passing through bracket (No 1975) The adjustment of each rod should be such that the washer just touches the safety dog (No 1969) Be positive that safety dogs clear the guide strips

GENERAL ADJUSTMENTS

Be careful to tighten all bolts and nuts, and, before using, go carefully over the joints of guide strips, leaving them perfectly smooth. For lubricating guide strips use a good quality of hard grease (not containing rosin.) Examine brake to see that shoe clears rim of wheel when released. All parts should operate freely, without binding or unnecessary friction.

NO. 2 CENTER LIFT HAND POWER ELEVATOR

THE No. 2 is a type of elevator expressly designed for heavy loads and hard service. To meet these requirements we furnish a strongly braced steel frame car (with ample counterbalance) and gearing of the highest efficiency. The rope or pull wheel may be placed at either the front or at the side, thus making it possible to install this type in either an open or enclosed hatchway.

We strongly recommend the sidepost arrangement shown in illustration. When conditions are such that the guide posts must be placed in the corners of hatchway, we can furnish special construction, for which drawings are necessary in each case to show size of hatchway required.

The illustration on the opposite page shows the construction to be a radical improvement over the old-fashioned "Wooden Type."

Specifications for the above are as follows:

Winding Machine
- Rope or Pull Wheel
- Shafts and Gearing
- Iron Drums
- Roller Bearings
- Steel Band Brake

Overhead Frames

Counterweights
- Adjustable

Platform—Steel Frame
- Safety Device

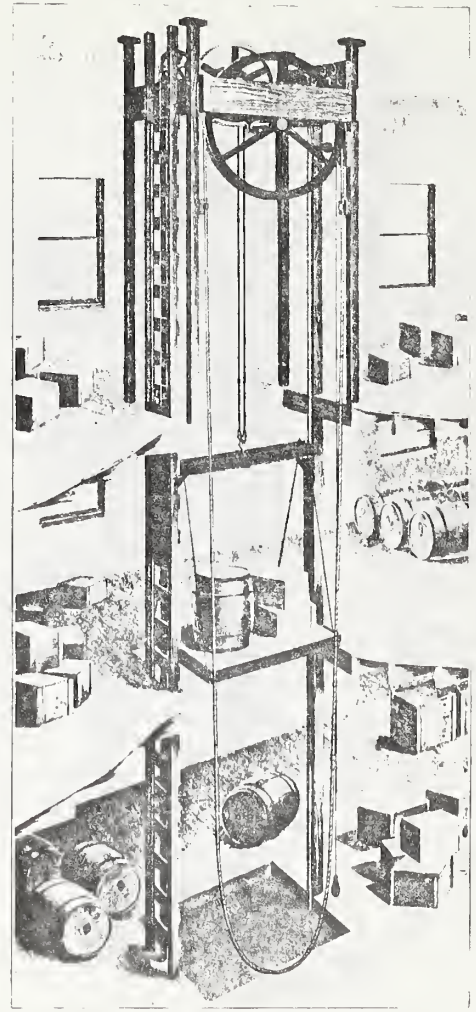
Guide Strips
- Maple

Ropes
- Two $\frac{1}{2}$" Iron Lifting Cables
- One $\frac{1}{2}$" Iron Weight Cable
- One $1\frac{1}{8}$" Manila Hand Rope
- One $\frac{1}{2}$" Brake Rope

We furnish complete drawings and instructions for erecting.

NO. 2 CENTER LIFT HAND POWER ELEVATOR

Capacities 1500, 2000, 2500 and 3000 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back
4′ 0″	x	5′ 0″	5′ 0″	x	7′ 0″
4′ 0″	x	6′ 0″	6′ 0″	x	6′ 0″
5′ 0″	x	5′ 0″	6′ 0″	x	7′ 0″
5′ 0″	x	6′ 0″	7′ 0″	x	7′ 0″

NO. 1 CARRIAGE TYPE ELEVATOR

THE No. 1, commonly called the "Carriage Elevator," is designed for use where the articles to be handled are large in size but light in weight. This type is used extensively in implement houses, livery stables, barns, etc.

Particular attention is called to the channel side rails on the platform; this makes a most rigid construction. Another important feature (to be found on all Otis Elevators of this type) is the beveled or sloping edges of the platform. This permits of an installation without the usually required pit, thus saving not only expense of erection, but also the necessity of cutting or otherwise disfiguring the lower floor.

Specifications for the above are as follows:

Winding Machine

Rope or Pull Wheel
Shafts and Gearing
Iron Drums
Roller Bearings
Steel Band Brake

Ceiling Sheaves and Hangers

Horizontal Supports for Winding Machine

Counterweights

Adjustable

Platform

Flat Bottom
Channel Side Rails

Guide Strips

Maple

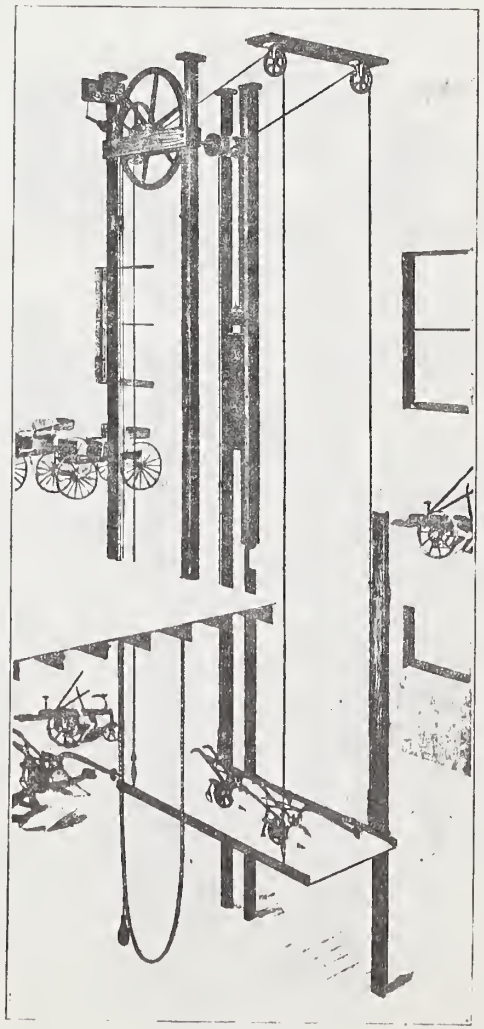
Ropes

Four $\frac{1}{2}$″ Iron Lifting Cables
One $\frac{1}{2}$″ Iron Weight Cable
One $1\frac{1}{8}$″ Manila Hand Rope
One $\frac{1}{2}$″ Brake Rope

We furnish complete drawings and instructions for erecting.

NO. 1 CARRIAGE TYPE ELEVATOR

Capacities 1500 and 2000 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back	Postwise		Front to back
6′ 0″	x	12′ 0″	6′ 0″	x	14′ 0″	7′ 0″	x	14′ 0″

NO. 2 CARRIAGE TYPE ELEVATOR

THE No. 2. or intermediate size of the "Carriage Type," meets the requirements of an ever-growing demand for a powerful, easy running automobile or wagon lift at a reasonable price. Its wide range of capacities, 2500, 3000 and 4000 pounds, *exclusive* of weight of car, makes this an ideal machine for general use.

Specifications for the above are as follows:

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Winding Machine
- Rope or Pull Wheel
- Shafts and Gearing
- Iron Drums
- Roller Bearings
- Steel Band Brake

Ceiling Sheaves and Hangers

Horizontal Supports for Winding Machine

Counterweights
- Adjustable

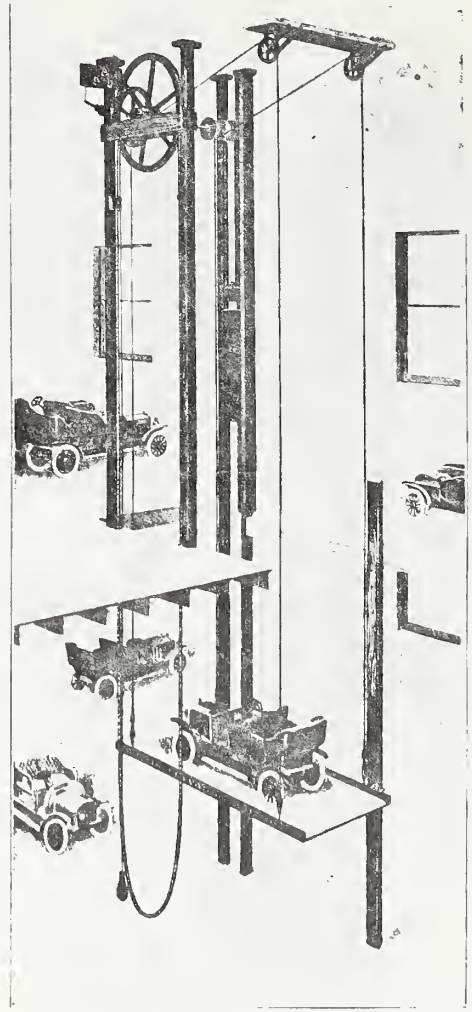
Platform
- Flat Bottom
- Channel Side Rails

Guide Strips
- Maple

Ropes
- Four $\frac{9}{16}$" Iron Lifting Cables
- One $\frac{9}{16}$" Iron Weight Cable
- One $1\frac{1}{8}$" Manila Hand Rope
- One $\frac{1}{2}$" Brake Rope

We furnish complete drawings and instructions for erecting.

NO. 2 CARRIAGE TYPE ELEVATOR
Capacities 2500, 3000 and 4000 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back
6′ 0″	x	12′ 0″	7′ 0″	x	16′ 0″
6′ 0″	x	14′ 0″	8′ 0″	x	16′ 0″
7′ 0″	x	14′ 0″	8′ 0″	x	18′ 0″

NO. 3 CARRIAGE TYPE ELEVATOR

THE lifting capacity and ease of operation of this elevator are increased materially beyond the range of the ordinary elevator of this general type by the adoption of a *Double Reduction Gear*, the use of which, combined with high-class workmanship, enables us to offer a machine to meet the maximum necessities of garage service.

If you wish to convert the second story of your garage into a "Money Maker" write us for prices and further particulars.

Specifications for the above are as follows:

Winding Machine
Rope or Pull Wheel
Double Gearing
Iron Drums
Roller Bearings
Steel Band Brake

Ceiling Sheaves and Hangers

Horizontal Supports for Winding Machine

Counterweights
Adjustable

Platform
Flat Bottom
Channel Side Rails

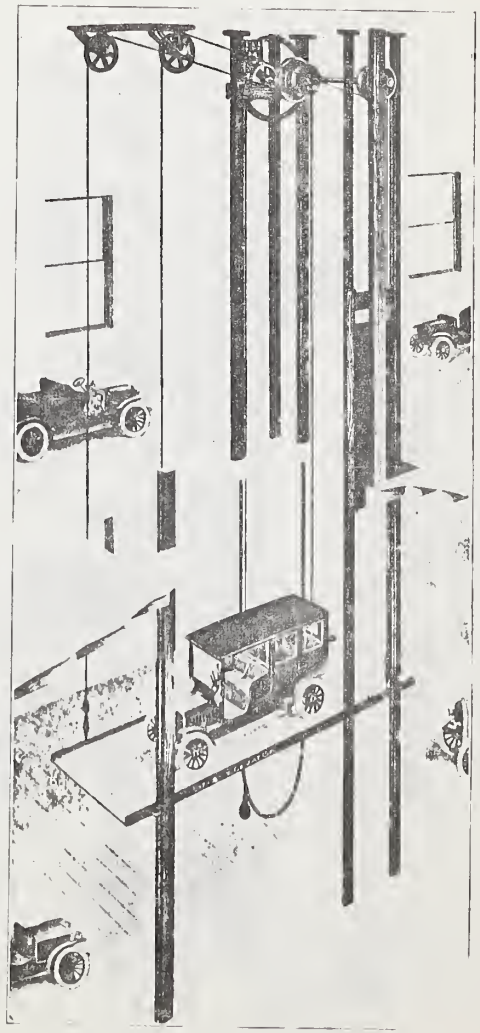
Guide Strips
Maple

Ropes
Four $\frac{5}{8}$" Iron Lifting Cables
One $\frac{5}{8}$" Iron Weight Cable
One $1\frac{1}{8}$" Manila Hand Rope
One $\frac{1}{2}$" Brake Rope

We furnish complete drawings and instructions for erecting.

NO. 3 CARRIAGE TYPE ELEVATOR

Capacities 5000 and 6000 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back
8′ 0″	x	16′ 0″	8′ 0″	x	20′ 0″
8′ 0″	x	18′ 0″	9′ 0″	x	18′ 0″

NO. 1 BASEMENT ELEVATOR

THE No. 1 "Basement" or "Sidewalk" Elevator is the acme of simplicity and perfection, and requires the smallest amount of space of any machine of this type yet produced.

By attaching the iron lifting cables to each side of the platform a very simple construction is obtained, while the equipment is made entirely self contained or self supporting except for the top and bottom anchorages, by carrying the drums and gearing on the guide angles.

The features outlined above result in a very considerable saving in erection labor.

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This type cannot be installed in an enclosed shaft, nor with the gears close to a wall or partition,—see page 28.

Specifications for the above are as follows:

Winding Machine
- Hand Wheel
- Shoe Brake
- Spur Gearing
- Iron Drums
- Steel Shaft
- Bearings

Platform

Guide Posts
- of Heavy Steel Angles

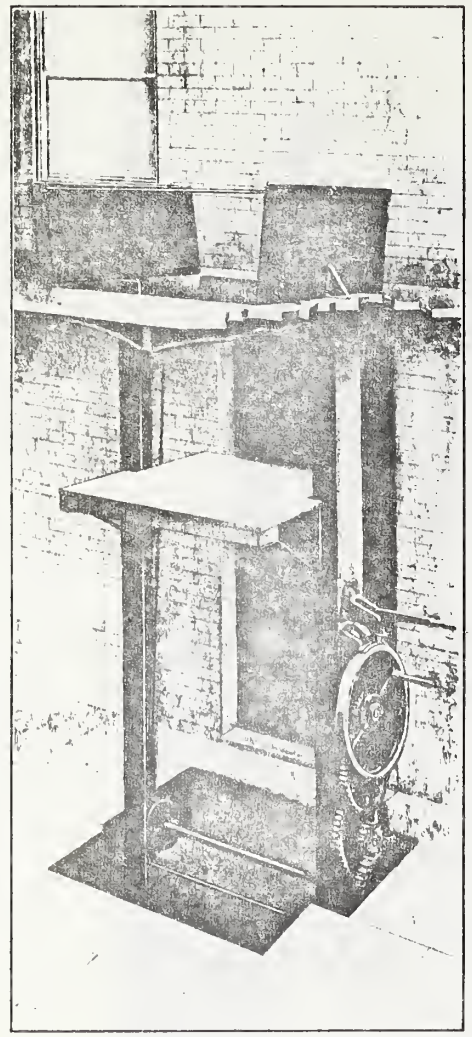
Overhead Sheaves

Ropes
- Two ½" Iron Lifting Cables

We furnish complete drawings and instructions for erecting

NO. 1 BASEMENT ELEVATOR

Capacities 500 to 2500 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back
3′ 0″	x	4′ 0″	6′ 0″	x	4′ 0″
4′ 0″	x	4′ 0″	″	x	5′ 0″
5′ ″	x	4′ 0″			

NO. 2 BASEMENT ELEVATOR

THE No. 2 "Basement" Elevator is of the same general design as the No. 1, but differs therefrom in the position of the hand wheel, which is set away from the main gearing. This arrangement is necessary where the gearing is too close to the wall to permit of operating the hand wheel as it is arranged on the No. 1.

Specifications for the above are as follows:

Winding Machine

- Hand Wheel
- Shoe Brake
- Spur Gearing
- Chain and Sprocket
- Iron Drums
- Steel Shaft
- Bearings

Platform

Guide Posts
- of Heavy Steel Angles

Overhead Sheaves

Ropes
- Two ½" Iron Lifting Cables

We furnish complete drawings and instructions for erecting.

• • •

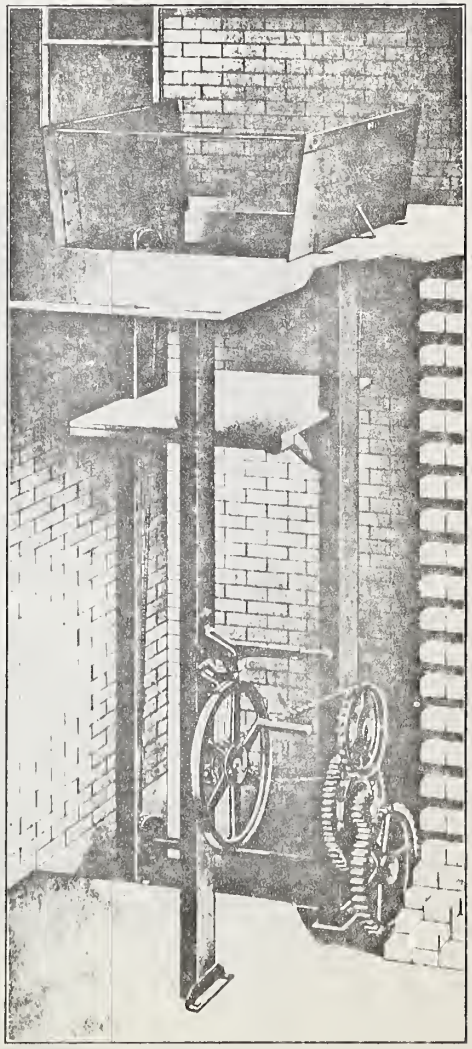
TRUNK LIFT AND INVALID HOIST

WHILE our No. 1 "Center Lift," shown on page 9, can be used for residence service, it is designed strictly as a freight elevator, and as such, is not equipped with all of the refinements which are usually required in residence lifts. We have therefore designed a special Hand Elevator for House Service, one that is smooth running, quiet, easily operated, and very moderate in price.

We will submit specifications and prices on request

NO. 2 BASEMENT ELEVATOR

Capacities 500 to 2500 lbs.



STANDARD SIZES

Postwise		Front to Back	Postwise		Front to Back
3′ 0″	x	4′ 0″	6′ 0″	x	4′ 0″
4′ 0″	x	4′ 0″	7′ 0″	x	5′ 0″
5′ 0″	x	4′ 0″			